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No. 9

On Al-Sūfi and Ptolemy's Catalogues. By Prof.
H. C. F. C. Schjellerup.

(Extract from a Letter to Mr. Knobel.)

“Having read your article in the number for June last of the *Monthly Notices*, and especially your remarks (page 419) on the great care which has always been taken by the scribes in ruling the necessary columns for entering the catalogues of stars in the two MSS. of Al-Sūfi at the British Museum and in the India Office Library, I am afraid that you use these MSS. in a perfectly wrong manner. The star magnitudes in these catalogues are evidently encumbered with slips of the pen and frequent forgetfulness of the qualifying letters.

“My own ‘Tableau synoptique’ as well as ‘les grandeurs’ in the special catalogues are only based on the ‘description’ which precedes the catalogue, where the magnitudes are expressed in words. If, therefore, the statements of the magnitudes in the MSS. in question are to be compared, it must be done exclusively by having recourse to the ‘description.’ In this way all my statements in the ‘Tableau synoptique’ can be controlled, even if by a misprint they should not be in conformity with the statement in the special catalogue. For instance, when (page 421) you meet with 3-2 for No. 4 *Cygni*, and you see that the catalogue contains 3, by turning to page 79 in my book you will be convinced that the catalogue is wrong, for the description says, ‘elle est des grandes de la troisième grandeur.’

“I take this opportunity to complain of a remark of yours in the *Monthly Notices*, January last, page 149.

“‘Professor Schjellerup, in his Al-Sūfi, gives Ptolemy’s cor-

rect description to the stars in question, and also to the red star *α Tauri*, but he appends the Arabic word *الخوصي*, which he translates "rouge," or "rougeâtre." Dr. Rieu, the Keeper of Oriental MSS. at the British Museum, and Dr. Redhouse inform me *there is no such Arabic word implying colour*. In fact, Professor Schjellerup translates the word as it ought to be, his Arabic MS. having an untranslatable word.'

"Dr. Redhouse is here in error. Turn up only Freytagii Lexicon Arabico-Latinum, s.v. *خوص*, and you will find 'ornavit laminis aureis (coronam).' I think that a designation of *α Tauri* as a 'golden' star is more proper than Dr. Redhouse's 'chest complaint look' about the same star.

"I should be glad if you would kindly cause the above to be inserted in an early number of the *Monthly Notices*.

"Copenhagen :
1885, Sept. 23."

Note on the above. By E. B. Knobel.

The remarks on page 419 of the June *Notices* quoted by Professor Schjellerup were not intended to be limited to MSS. of *Al-Sūfi*, but to apply to all the Oriental MSS., both Arabic and Persian, of Ptolemy, *Al-Sūfi*, and *Ulugh Beigh*, which I had examined. The object of the paper was *solely* to show that in these MSS. errors of transcriber and translator are so frequent and so rife that we are not yet in a position to assume that any differences we find in the star magnitudes of *Al-Sūfi* and *Ulugh Beigh* may not be due to such errors.

Professor Schjellerup takes exception to my remarks (p. 149 of the January *Notices*) on his translation of the Arabic word *الخوصي* as "rouge" or "rougeâtre."

The word *خوص*, which he gives as his authority from Freytag, is one which I had carefully considered and discussed with Dr. Redhouse when preparing the paper. I hardly think that his translation of it as "golden" can be at all sustained. The noun *خوص* means "the leaves or the fronds of the date palm," and the verb *خوص* (with reduplication of the second letter) means "put forth leaves (the tree)." In Lane's dictionary the sentence in Freytag, quoted by Professor Schjellerup, is thus given: "he ornamented (the crown) with plates of gold of the width of palm leaves." The use of the word *خوص* here refers to the *shape*, and not to any colour. I think it extremely unlikely that the solution of the difficulty can be found in the word *خوص* as the authorities I have consulted do not agree with Professor Schjellerup that it can be used in a sense implying colour.

The Horizontal and Vertical Diameters of the Sun as observed with the Greenwich Transit Circle.
 *By W. G. Thackeray.

(Communicated by A. M. W. Downing.)

The following table is formed by taking from one of the sections of the *Greenwich Observations* the daily errors of the *Nautical Almanac* horizontal diameter of the Sun, as given by each of the regular observers for the years 1861-83, and ranging them under each observer's name. The tabular figures represent the mean annual error, with the number of observations on which the value depends, subscribed.

Tabular Errors of the Sun's Horizontal Diameter as computed in the "Nautical Almanac."

Year.	Dunkin.	Ellis.	J. Carpenter.	Criswick.	Lynn.	Downing.	Thackeray.	Lewis.	Hollis.
1861		"	"	"	"	"	"	"	"
	+ 0'036 ₁₁	+ 0'080 ₁₇	+ 0'091 ₇	- 0'013 ₁₆					
1862		+ 0'145 ₁₃	+ 0'176 ₁₁	+ 0'047 ₁₈					
1863		+ 0'123 ₂₅	+ 0'227 ₂₂	+ 0'007 ₂₀					
1864		+ 0'054 ₂₃	+ 0'174 ₁₉	+ 0'011 ₂₅					
1865		+ 0'093 ₂₂	+ 0'190 ₁₈	- 0'009 ₂₄					
1866		+ 0'113 ₂₀	+ 0'136 ₁₇	- 0'028 ₁₆					
1867		+ 0'114 ₁₇	+ 0'166 ₁₃	+ 0'056 ₁₁					
1868		+ 0'074 ₁₆	+ 0'208 ₁₀	+ 0'027 ₂₃					
1869		+ 0'100 ₁₈	+ 0'187 ₁₂	+ 0'031 ₁₅					
		+ 0'091 ₁₇	+ 0'194 ₂₀	+ 0'041 ₁₇	+ 0'100 ₁₄				

Taking the mean errors of the vertical diameter, as given by the same observers from my former paper in the June number, and multiplying by 14 to convert into seconds of arc, we get—

	Dunkin.	Ellis.	J. Carpenter.	Criswick.	Lynn.	Downing.	Thackeray.	Lewis.	Hollis.	Mean Obs.
Errors of Vertical Diameter	" + 2.28	" - 0.19	" + 3.13	" + 1.65	" - 1.59	" + 1.70	" + 1.01	" + 0.48	" + 0.15	" + 1.11
Errors of Horizon. Diameter	+ 0.76	+ 1.44	+ 2.42	+ 0.28	+ 0.91	+ 1.15	+ 0.45	+ 1.54	+ 1.12	+ 1.08
Vert. Diam. - Horizon. Diam.	- 1.52	+ 1.63	- 0.71	- 1.37	+ 2.50	- 0.55	- 0.56	+ 1.06	+ 0.97	+ 0.03

The chief points of interest involved in these results seem to be—

1. The several observers differ in their estimate of the Sun's vertical diameter by as much as 4".8, whereas they only differ 2".2 in their estimate of the horizontal diameter.
2. While the "mean observer" makes the Sun quite circular, none of the observers themselves do so, but are equally divided as to which diameter is the larger, the range amounting to 4".
3. It would appear as if observers find greater difficulty in placing the moveable wires of the Z. D. micrometer, so as to form a contact with the limb, which is virtually at rest in the direction of measurement, than they do in estimating the moment when the moving limb forms a contact with the fixed wires. More time to think produces greater divergence of opinions.

On a Suspected New Variable Star in Corona Borealis.

By G. F. Chambers.

In Birmingham's very interesting and valuable Catalogue of Red Stars (*Transactions, Royal Irish Academy*, vol. xxvi., p. 281) there occurs under the number 361 an entry as follows:—

“ ‘Cape Obs.: fine ruby; 9.5.’ *B's Obs.*: 1873, March 14 and 19, and April 20, not seen. 1874, April 10, not seen. *Dublin Obs.*: Ball, 1876, Aug. 1, no star of 8.5 mag. in this position.”

The position given by Birmingham is (for 1885) as follows:—

R.A. 15^h 45^m 26^s. Decl. +39° 54'7.

In the course of a systematic re-observation of all Birmingham's red stars, which I have been carrying on for some years past, I came to Birmingham's 361st object on 1885, August 13, and setting my telescope to the assigned place I found at once in the field a conspicuously red star which could not possibly have escaped the notice of two such experienced observers as Mr. Birmingham and Dr. Ball had it been visible in 1873-4-6.

I will here transcribe the entry made in my Observatory Book under 1885, August 13:—

“ A star, distinctly red, found in $\delta + 39^\circ 55'$ and slightly, say 32^s , *f*, as estimated by reticulated micrometer, the place assigned for 361 Birm. Colour, most evident; mag. say 8. The field contained an equilateral triangle of stars, one side of which was nearly in the Meridian; the suspected var. was about two-fifths the distance from corner to corner of the triangle, reckoning from N. to S. The most southerly star and the suspected var. were about equal—perhaps the star slightly the brighter—but the other two stars of the triangle were each somewhat fainter.”

I was thus particular in writing down these details in order to facilitate the re-observation of the group next year after conjunction with the Sun. The Declination circle of my instrument (6-inch Grubb, power 75) was in good adjustment, and I can rely on the value given above for the Declination of the star, but I am less able to guarantee the exactness of the R.A. to a few seconds. It is to be noted, however, that Birmingham's Catalogue contains no star anywhere within reach which I could have mistaken.

Sir J. Herschel having seen this star at the Cape about 1830, and Birmingham and Ball having missed it 1873-6, I hope it will hereafter appear that I was justified in reporting it as an addition to our list of known variables. I have examined the star on several occasions since August 13, but I am not as yet able to feel sure that it has undergone any change.

Northfield Grange Observatory,
Eastbourne, Sussex:
1885, Sept. 28.

*Observations of Comet 1884 I. (Pons-Brooks) made at the Royal Observatory, Cape of Good Hope.**(Communicated by D. Gill, LL.D., F.R.S., H.M. Astronomer.)*

1884.	Cape Mean Time.		Comet- $\star$ $\Delta\alpha$		No. of Comp.	Obs- ver.	Comet's App. R.A.		Log. par. factor.	Comet's App. Dec.	Log. par. factor.	Reductions to Apparent Place.	Comp. Star.
	$^{\text{h}}$	$^{\text{m}}$ $^{\text{s}}$	$^{\text{m}}$ $^{\text{s}}$	$^{\text{h}}$ $^{\text{m}}$ $^{\text{s}}$			$^{\text{h}}$ $^{\text{m}}$ $^{\text{s}}$	$^{\text{h}}$ $^{\text{m}}$ $^{\text{s}}$				$^{\text{s}}$ $^{\text{h}}$	
Jan. 16	8 38	38.2	-2 3.65	23 23 28.29	4	F	23 23 28.29	8.729		-4 37 19.7	9.731 _n	-0.08 + 0.8	1
	8 47	0.6	+5 55.6		3	F				-17 35 56.8	9.657 _n	-0.12 - 4.9	1
24	8 45	13.2	+5 34.6		4.4	F	0 9 8.20	8.744					2
	8 53	42.2	-0 51.39		8	F	0 9 7.28	8.749					2
26	8 44	29.2	-3 27.81		8.8	F	0 11 32.46	8.772		-20 37 19.8	9.710 _n	-0.15 - 6.0	3
28	9 7	36.1	+3 25.46		6.7	F	0 19 25.31	8.773		-23 16 11.1	9.654 _n	-0.21 - 6.7	4
29	8 44	31.5	-1 30.04		8.8	F	0 23 4.33	8.767		-24 29 29.9	9.612 _n	-0.21 - 7.4	5
Feb. 2	8 37	5.3	-0 25.57		3.3	F	0 36 40.74	8.786		-29 0 57.2	9.580 _n	-0.29 - 8.9	6
	8 46	21.4	-6 18.13		2.2	F	0 36 42.45	8.790		-29 1 20.1	9.596 _n	-0.26 - 9.3	7
4	8 25	35.6	+1 24.83		8.8	F	0 42 47.55	8.783		-31 1 38.0	9.515 _n	-0.34 - 9.5	8
6	8 27	16.6	+0 4.11		20.20	F	0 48 32.92	8.795		-32 54 4.8	9.504 _n	-0.38 - 10.1	9
7	8 33	44.0	-2 39.04		8.8	F	0 51 17.98	8.804		-33 47 42.0	9.513 _n	-0.38 - 10.5	10
9	8 51	35.7	+0 3.21		12	F	0 56 34.50	8.823				-0.42 - 11.1	11
	9 3	28.4	-8 1.6		10	F				-35 29 26.7	9.577 _n		11

1884.	Cape Mean Time.	Comet- Δ		Comet- Δ		No. of Comp.	Obs- ver.	Corrct's App. R.A.		Log. par. factor	Comet's App. Dec.	Log. par. factor.	Reductions to Apparent Place.	Compt. Star.
	h m s	Δ_1	Δ_2	Δ_3	Δ_4			h m s						
Feb. 10	8 36 49.0	-1 56.86	-1 56.86	+0 54.5	"	12.12	F	0 59 29.0	8.821		-36 16 9.5	9.503 _n	-0.46	12
12	8 50 55.2	-0 36.28	-0 36.28	-0 24.5	"	10.10	F	1 3 53.55	8.837		-37 47 1.3	9.534 _n	-0.52	13
15	8 25 36.4	+0 52.97	+0 52.97	+1 35.2	"	10.10	F	1 10 39.46	8.841		-39 51 15.7	9.445 _n	-0.59	14
17	8 33 35.0	-2 5.19	-2 5.19	-2 38.9	"	6.6	F	1 14 56.84	8.855		-41 7 43.1	9.468 _n	-0.65	15
18	8 50 39.8	-1 22.09	-1 22.09	+7 48.8	"	12.12	F	1 17 4.81	8.866		-41 44 48.5	9.523 _n	-0.68	16
19	8 35 31.4	-2 43.13	-2 43.13	+1 21.5	"	4.4	F	1 19 7.41	8.865		-42 19 49.1	9.472 _n	-0.70	17
22	9 15 5.5	+1 54.24	+1 54.24	-6 16.1	"	6.6	F	1 25 13.13	8.886		-44 1 14.3	9.597 _n	-0.81	18
24	7 35 0.1	+0 6.69	+0 6.69	-4 50.8	"	12.12	F	1 29 0.92	8.853		-45 1 40.0	9.173 _n	-0.86	19
25	8 0 54.0	-0 46.35	-0 46.35	-8 16.4	"	12.12	F	1 30 59.92	8.877		-45 32 20.5	9.324 _n	-0.89	20
26	8 22 21.8	-2 11.65	-2 11.65	-2 29.6	"	10.10	F	1 32 58.16	8.893		-46 2 9.7	9.424 _n	-0.91	21
27	8 10 44.3	-1 51.73	-1 51.73	+5 12.1	"	10.10	F	1 34 53.73	8.892		-46 30 39.3	9.373 _n	-0.97	22
29	8 28 5.4	-2 41.55	-2 41.55	+5 10.3	"	10.10	F	1 38 48.25	8.908		-47 26 36.7	9.447 _n	-1.01	23
Mar. 2	8 19 4.1	-2 58.67	-2 58.67	+3 59.7	"	12.12	F	1 42 40.76	8.914		-48 19 50.1	9.418 _n	-1.07	24
3	7 55 18.1	+0 46.75	+0 46.75	-0 53.9	"	6.6	F	1 44 36.51	8.909		-48 45 24.0	9.306 _n	-1.13	25
4	7 59 36.2	-1 10.03	-1 10.03	+0 50.6	"	12.12	F	1 46 35.40	8.915		-49 10 55.7	9.328 _n	-1.15	26
7	8 18 23.9	+0 56.93	+0 56.93	-0 50.2	"	20.20	F	1 52 36.82	8.935		-50 25 19.3	9.429 _n	-1.26	27
8	8 19 52.3	-0 8.11	-0 8.11	-6 58.0	"	10	F	1 54 38.69	8.940		-50 49 31.0	9.479 _n	-1.28	28
	8 29 22.2					10	F							28

Mean Places of Comparison Stars.

No. of Star.	Mag.	Mean R.A. 1834°.			Mean Dec. 1834°.			Authority for Star's Place.
		h	m	s	°	'	"	
1		23	25	32.02	—	4	43 16.1	3 Meridian Obs. Cape, 1884 = Lalande 46057.
2	10	0	9	59.71	—	17	41 26.5	Equat. diff. from * a.
a	8½	0	7	19.23	—	17	49 49.0	3 Meridian Obs. Cape.
3	8½	0	15	0.42	—	20	34 23.8	2 „ „
4	8½	0	16	0.06	—	23	17 4.6	A.Oe. 139 + Gould 0 ^b 408.
5	5	0	24	34.58	—	24	25 45.4	Stone 179, Gould 0 ^b 639.
6	10½	0	37	6.60	—	28	57 35.4	2 Meridian Obs., Cape.
7	6	0	43	0.84	—	29	7 37.7	Stone 319.
8	9	0	41	23.06	—	30	59 28.5	2 Meridian Obs., Cape.
9	6½	0	48	29.19	—	32	57 52.8	Stone 353.
10	9½	0	53	57.40	—	33	43 49.2	3 Meridian Obs., Cape.
11	10	0	56	31.71	—	35	21 14.0	Equat. diff. from Stone 429.
12	6	1	1	0.22	—	36	16 52.9	Stone 431.
13	10½	1	4	30.35	—	37	46 25.4	3 Meridian Obs., Cape.
14	10½	1	9	47.08	—	39	52 38.8	Equat. difference from * b.
b	8	1	14	19.09	—	39	58 26.9	2 Obs. Cape: Gould 1 ^b 362.
15	9½	1	17	2.69	—	41	4 52.1	„ Gould 1 ^b 429.
16	6½	1	18	27.58	—	41	52 25.1	Stone 545.
17	6	1	21	51.24	—	42	20 58.2	„ 568.
18	3	1	23	19.70	—	43	54 46.0	„ 580.
19	8	1	28	55.09	—	44	56 36.8	Gould 1 ^b 755.
20	9	1	31	47.16	—	45	23 51.7	„ 1 ^b 833.
21	9	1	35	10.72	—	45	59 27.5	2 Meridian Obs., Cape.
22	8	1	36	46.41	—	46	35 39.1	Equat. diff. from Stone 646.
23	9½	1	41	30.81	—	47	31 34.3	1 Obs. Cape: Gould 1 ^b 1055.
24	5½	1	45	40.50	—	48	23 37.1	Stone 732.
25	9½	1	43	50.89	—	48	44 17.9	Equat. diff. from * c.
c	9	1	42	41.90	—	48	48 13.2	1 Obs. Cape: Gould 1 ^b 1086.
26	9½	1	47	46.58	—	49	11 33.8	„ „ 1 ^b 1233.
27	6½	1	51	41.15	—	50	24 16.8	Stone 769: Gould 1 ^b 1331.

No. of Star.	Mag.	Mean R.A. 1884°.	Mean Dec. 1884°.	Authority for Star's Place.
		^h ^m ^s	[°] ['] ^{''}	
28	8½	1 54 48.08	-50 42 20.7	2 Obs. Cape: Gould 1 ^h 1437.
29	8½	1 55 26.36	-51 7 44.2	Gould 1 ^h 1466.
30	9	2 8 33.32	-53 1 47.0	2 Obs. Cape, 1884.
31	9	2 15 16.44	-53 43 48.1	1 Obs. Cape: Gould 2 ^h 394.
32	9½	2 21 28.91	-55 42 16.4	2 Obs. Cape, 1884.
33	10	2 25 26.04	-55 57 38.8	Equat. diff. from * <i>d</i> .
<i>d</i>	9½	2 24 38.24	-55 54 4.5	1 Obs. Cape: Gould 2 ^h 651.
34	10	2 31 17.43	-56 45 37.8	Equat. diff. from * <i>e</i> .
<i>e</i>	8½	2 29 43.19	-56 49 40.0	2 Obs. Cape, 1884.
35	9½	2 41 20.98	-57 39 49.3	"
36	8	2 45 2.04	-58 8 44.4	Gould 2 ^h 1231.
37	8	2 54 40.06	-59 22 9.9	1 Obs. Cape: Gould 2 ^h 1483.
38	9½	3 41 29.56	-63 32 48.4	Equat. diff. from * <i>f</i> .
<i>f</i>	9	3 44 36.47	-63 31 19.6	1 Obs. Cape: Gould 3 ^h 1347.
39	10½	3 43 53.16	-63 48 40.9	Equat. diff. from * <i>g</i> .
<i>g</i>	9	3 41 28.06	-63 48 50.7	1 Obs. Cape: Gould 3 ^h 1243.
40	9	4 21 54.86	-65 59 57.3	" " 4 ^h 711.
41	8	4 24 49.73	-66 4 16.5	" " 4 ^h 823.
42	8½	4 29 34.34	-66 21 38.1	2 Obs. Cape, 1884.
43	10½	4 49 25.95	-67 9 53.0	Equat. diff. from * <i>h</i> .
<i>h</i>	9	4 49 15.70	-67 1 36.8	2 Obs. Cape, 1884.
44	9	5 10 5.91	-68 0 29.1	" "

Notes.

Jan. 16. Head very bright.

24. Tail faint and less than 2° in length; quite straight.

28. Observations interfered with by clouds.

29. No trace of a stellar nucleus could be seen.

Feb. 4. Stellar nucleus, surrounded by coma almost as bright.

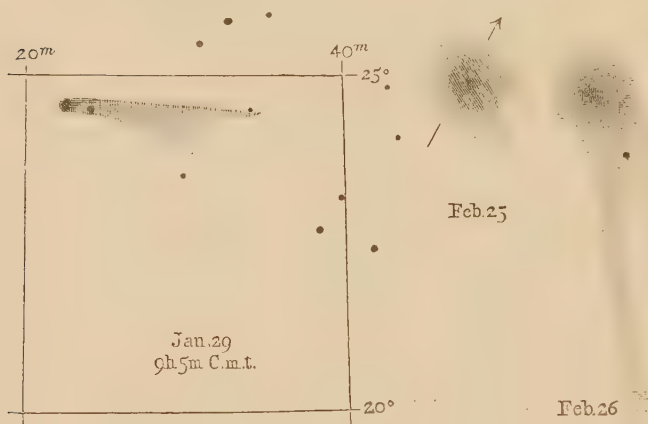
6. Head much more diffused.

9. Poor definition. Comet's head very diffused; takes about 1^s to transit the wire.

15. Tail very faint. At 8^h 15^m mean time I can trace it in the finder to the bright star following, and about half as far again. It is narrow and straight; the bright star is just inside its southern edge.

25. A very faint tail visible in the finder; position-angle approximately 134°.

- Feb. 26. Position angle of tail = 114° . Traces of another very faint tail could just be seen at position angle $153^\circ \pm$ (see figure).
 29. Definition poor, looking through vapour on the mountain. Comet a difficult object to bisect.
- Mar. 2. Occasional glimpses of a star-like nucleus: the point observed was in following part of head (where the nucleus was seen).
 21. Head bright, but ill-defined, surrounded by nebulous mass. Still faint trace of very short tail.
- Apr. 13. An 11th magnitude star near the Comet very troublesome. The Comet was almost centrally over this star earlier in the evening, and the star then was brighter than when the Comet had passed away from it. The moonlight was, however, increasing rapidly towards the end of the measures.
21. Exceedingly faint.



Observations of Comet 1884 II. (Barnard), made at the Royal Observatory, Cape of Good Hope.

(Communicated by David Gill, LL.D., F.R.S., H.M. Astronomer.)

The following observations are in continuation of those given in vol. xlv. 1:—

Date.	Cape Mean Time.	Comet—Star. $\Delta \alpha$	Δ N.P.D.	No. of Comp.	Observer.	Comparison Star.
Oct. 14	9 53 42.7	—0 6.41	+4 38.1	32.16	F	$r = \text{AOe}_2 21151.$
15	9 45 49.0	—0 4.28	—2 33.9	24.16	F	s
16	11 1 50.6	—0 17.32	—2 37.0	16.12	F	t
17	9 56 51.5	+0 35.86	+3 42.1	24.16	F	v
20	10 33 4.0	—0 1.70	—1 31.2	16.8	F	w
24	10 26 26.6	—0 30.77	+0 49.1	6.14	F	x

Observations of Comet 1884 (Wolf) made at the Royal Observatory, Cape of Good Hope.

(Communicated by D. Gill, LL.D., F.R.S., H.M. Astronomer).

1884.	Cape Mean Time.	Comet - $\star$ $\Delta\alpha$	No. of Comp.	Obs- vor.	Comet a App. h m s	Log. (p x Δ)	Count δ App. " "	Log. (p / Δ)	Red. to App. Place, s	Comp. Star No.
Oct. 20	8 49 36.7	-0 32.94	30.16	F	21 47 43.01	8.175	+8 11 1.0	9.822 _n	+3.21 +28.8	1
23	10 45 1.3	+0 51.91	8.6	F	21 53 8.77	8.601	+6 45 53.0	9.793 _n	+3.19 +28.4	2
24	9 18 12.4	+0 19.88	14.20	F	21 54 51.27	8.280	+6 20 58.5	9.803 _n	+3.20 +28.2	3
25	9 27 16.9	+0 35.23	16.20	F	21 56 45.52	8.406	+5 54 38.6	9.798 _n	+3.19 +28.1	4
Nov. 3	8 51 22.4	+0 38.90	10.8	F	22 14 54.58	8.326	+2 17 27.1	9.767 _n	+3.16 +26.8	5
4	8 57 23.1	-0 31.73	12.12	F	22 17 3.96	8.361	+1 55 14.9	9.763 _n	+3.18 +26.7	6
6	8 54 24.9	+0 35.08	14.6	F	22 21 26.87	8.365	+1 12 45.0	9.757 _n	+3.16 +26.3	7
8	8 34 19.1	+0 12.69	30.20	F	22 27 1.55	8.288	+0 34 2.0	9.750 _n	+3.18 +26.0	8
10	8 37 9.3	+0 46.56	20.16	F	22 30 27.40	8.317	-0 6 24.8	9.743 _n	+3.16 +25.7	9
12	8 30 10.3	+0 21.98	20.16	F		8.298		9.737 _n	+3.15 +25.4	10
17	8 30 4.2	-1 5.27	16.12	F		8.336		9.722 _n	+3.15 +24.4	11
18	8 35 57.6	+0 51.86	16.8	F	22 49 24.36	8.473	-2 21 1.2	9.721 _n	+3.16 +24.3	12
25	8 29 30.9	-1 29.69	10.8	F		8.382		9.702 _n	+3.16 +22.9	13
Dec. 9	8 56 6.8	+0 34.17	20.16	F	23 42 32.76	8.527	-5 45 42.2	9.687 _n	+3.15 +20.2	14
15	8 42 30.5	+0 36.99	20.16	F		8.315		9.682 _n	+3.15 +19.0	15
1885. Jan. 7	8 55 24.5	-0 33.58	8.1	F	0 57 2.05	8.609	-5 53 7.0	9.693 _n	+0.16 -5.2	16
10	8 49 11.8	+0 43.91	7.8	F	1 4 34.79	8.607	-5 41 26.9	9.695 _n	+0.15 -5.6	17

1885,	Cape Mean Time.		Comet— Δ		No. of Comp.	Obser- ver.	Comet α App.			Log. ($p \times \Delta$)	Comet δ App.			Log. ($p \times \Delta$)	Red. to App. Place.	Comp. Star. No.
	h	m	s	Δ	Δ		h	m	s		$^{\circ}$	$'$	$''$			
Jan. 12	9	1	2.7	-0 42.18	+0 52.3	12.12	F	1	9	37.64	8.632	-5 32	47.1	9.700 _n	+0.16	18
14	9	4	2.4	+0 59.92	+3 8.3	16.12	F	1	14	38.32	8.640	-5 23	31.9	9.703 _n	+0.16	19
15	8 53	51.8	-1 21.91	-3 40.9	8.12	F	1	17	7.19	8.627	8.627	-5 18	27.4	9.702 _n	+0.18	20
19	8 46	6.2	+0 19.39	+0 3.8	13.12	F	1	27	2.01	8.623	8.623	-4 57	23.9	9.704 _n	+0.18	21
20	8 54	30.0	-1 22.77	+1 39.4	12.14	F	1	29	31.77	8.638	8.638	-4 51	48.6	9.707 _n	+0.20	22
21	8 51	39.5	+0 35.00	-2 12.7	12.8	F	1	32	0.15	8.637	8.637	-4 46	9.1	9.708 _n	+0.18	23
Feb. 12	8 28	59.3	-0 47.51	+3 28.4	16.8	F	2	25	12.30	8.652	8.652	-2 19	22.4	9.728 _n	+0.19	24
13	8 34	11.3	+0 43.86	+3 53.2	16.12	F	2	27	35.16	8.660	8.660	-2 12	8.4	9.730 _n	+0.20	25
14	8 34	24.2	+0 27.67	+0 0.5	16.12	F	2	29	58.83	8.662	8.662	-2 4	54.4	9.731 _n	+0.19	26

The comet was also observed on the Meridian on two occasions:—

Oct. 24	7 40	32.4	.	6.1	F	21 54	45.98	+6 22	52.7	9.809 _n
25	7 38	27.9		6	F	21 56	37.66			

Notes.

Nov. 3. Comet very faint: moonlight and haze.

6. Measures frequently interrupted by cloud.

18. Only one comparison (through cloud) was obtained between stars 12 and *h*.

Dec. 9. Nucleus = star of 11th magnitude.

Jan. 10. Comet faint: hazy.

21. Comet very faint: moonlight: a very faint star near the comet was troublesome.

Errata.—W.B. xxii. 574. This star is Lalande 44096 and Glasgow 5876. The R.A. given in W.B. is about 20' too great.

W.B. i. 122 and 126. The differences between these two stars, measured on Jan. 12, were 21.68 and 5' 20". The place of the second star given in W.B. requires a correction of -2' in declination.

W.B. i. 183. Precession in R.A. for 3.018 read 3.028. W.B. i. 514. Precession in Dec. for 19" 59 read 18" 59.

Assumed Mean Places of Comparison Stars.

Comp. Star. No.	Mag.	α 1884 ^o .			δ 1884 ^o .			Authority.
		h	m	s	h	m	s	
1	9	21	48	12.74	+8	9	53.4	2 Obs. Cape (= W.B. xxi. 1095).
2	9½	21	52	13.67	+6	43	32.6	Equat. diff. from * a.
a	9	21	50	43.10	+6	41	34.8	1 Obs. Cape (= W.B. xxi. 1150).
3	9	21	54	28.19	+6	20	4.1	Equat. diff. from * b.
b	9½	21	55	6.36	+6	16	15.8	Equat. diff. from * c.
c	6	21	54	20.29	+6	9	43.1	= 18 Pegasi ½ (Gr. '64 + Yarn.)
4	9½	21	56	7.10	+5	51	46.3	Equat. diff. from * d.
d	8½	21	54	57.47	+5	46	22.8	2 Obs. Cape
5	9	22	14	12.52	+2	12	4.6	2 Obs. Cape (= W.B. xxii. 247).
6	9½	22	17	32.51	+1	58	20.1	Equat. diff. from * e.
e	9	22	18	54.64	+2	3	58.1	1 Obs. Cape (= W.B. xxii. 366).
7	9	22	20	48.63	+1	8	21.7	Equat. diff. from * f.
f	8½	22	21	54.41	+1	3	57.9	1 Obs. Cape (= W.B. xxii. 437).
8		22	26	45.68	+0	30	28.0	Astr. Nach. No. 2644.
9	10½	22	29	37.68	-0	5	6.3	Equat. diff. from * g.
g	8	22	28	39.98	-0	0	4.0	1 Obs. Cape (= W.B. xxii. 574).
10		22	34	41	-0	41		(= Arg. -0° 4399).
11	9½	22	48	(3)	-2	9		
12	10	22	48	(29.34)	-2	21	(11.8)	Equat. diff. from * h.
h	9	22	47	12.04	-2	14	40.6	W.B. xxii. 953.
13	9	23	8	(28)	-3	53		
14	8	23	41	55.44	-5	52	48.5	W.B. xxiii. 821.
15	9	23	57	(44)	-6	4		
16	10½	0	57	35.47	-5	54	9.9	Equat. diff. from * i.
i	8	0	58	47.95	-5	26	25.9	W.B. o, 1003.
17	9	1	3	50.73	-5	38	37.0	W.B. i. 12.
18	8½	1	10	19.66	-5	33	33.4	W.B. i. 122.
19	9½	1	13	38.24	-5	26	33.9	Equat. diff. from * k.
k	8½	1	13	43.30	-5	31	2.0	W.B. i. 183.
20	10½	1	18	28.92	-5	14	40.1	Equat. diff. from * l.
l	8½	1	20	32.02	-5	16	7.5	W.B. i. 315.
21	10	1	26	42.44	-4	57	20.8	Equat. diff. from * 22.
22	9	1	30	54.34	-4	53	20.9	W.B. i. 502.
23	8	1	31	24.97	-4	43	49.2	W.B. i. 514.
24	10	2	25	59.62	-2	22	41.0	Equat. diff. from * 25.
25	9	2	26	51.10	-2	15	51.8	W.B. ii. 422.
26	10	2	29	30.97	-2	4	45.0	Equat. diff. from * m.
m	9½	2	33	7.20	-2	4	56.9	W.B. ii. 537.

Observations of Comet 1885 . . . (Barnard) at Harrow with the 18-inch Equatorial Reflector and Ring Micrometer.
 By G. L. Tupman.

	Green Mean Time,	$\Delta\alpha$	δ	$\Delta\delta$	No. of Comps.	ϕ app. α	ϕ app. δ	Log. fac. Parallax.	*
	h m s	$^{\circ}$	$'$	$''$		h m s	$^{\circ}$ $'$ $''$		
1885, July 15	10 48 22.8	+ 2.55	- 7 54.3		6	17 7 25.18	- 9 16 31.6	+ 8.137	+ 9.938
	12 17 0.7	- 4.07	- 10 4.4		22	17 7 17.00	- 9 18 41.7	+ 8.444	+ 9.928
July 17	10 35 49.1	+ 31.87	- 1 2.8		24	17 4 1.24	- 10 23 14.1	+ 8.128	+ 9.942
	10 50 38.7	+ 29.93			6	17 3 59.30		+ 8.244	

The comet was very faint, the sky being hazy on both nights; some 30" or 40" diameter, with central condensation admitting of pretty accurate observation. All the transits were registered on the chronograph. The apparent places of the comet differ slightly from those published in the *Astr. Nach.*, No. 2676, the places of the stars being derived from recent observations.

Main Places of the Comparison Stars for 1885.0.

	h	m	s	$^{\circ}$	$'$	$^{\circ}$	$'$
1	17	7	19.68	+ 2.95	- 9 5 48.6	+ 8.3	Harrow Meridian Obs. 1885. 3, 3
2	17	3	26.42	+ 2.95	- 10 22 19.4	+ 7.9	Greenwich Obs. 1883-84. 3, 3*

* By permission of the Astronomer Royal.

On the Proper Motions of the Stars LL. 31296 and 31188.

By G. L. Tupman.

LL. 31296. For this star we have the following observations reduced to 1885.0 by Peters' constants:—

	R.A.			Decl.			
	h	m	s	°	'	"	
1800	17	7	19.35	-9	8	45.5	LL. 31296
1825			19.86			47.5	W.B. 58,* 83
1850			19.60			44.7	Lam, 2078
1860			19.55			44.2	Yarnall 7133, 2 Obs.
1860			19.55			43.8	Schj. 6146

The star was observed three times on the Meridian at Harrow:—

	h	m	s	°	'	"
	17	7	19.80	-9	8	44.8
			19.65			46.4
			19.59			45.6
1885.56	17	7	19.68	-9	8	45.6

The Annual Proper Motion appears to be quite insensible.
LL. 31188. For this star, reduced to 1885.0, we have:—

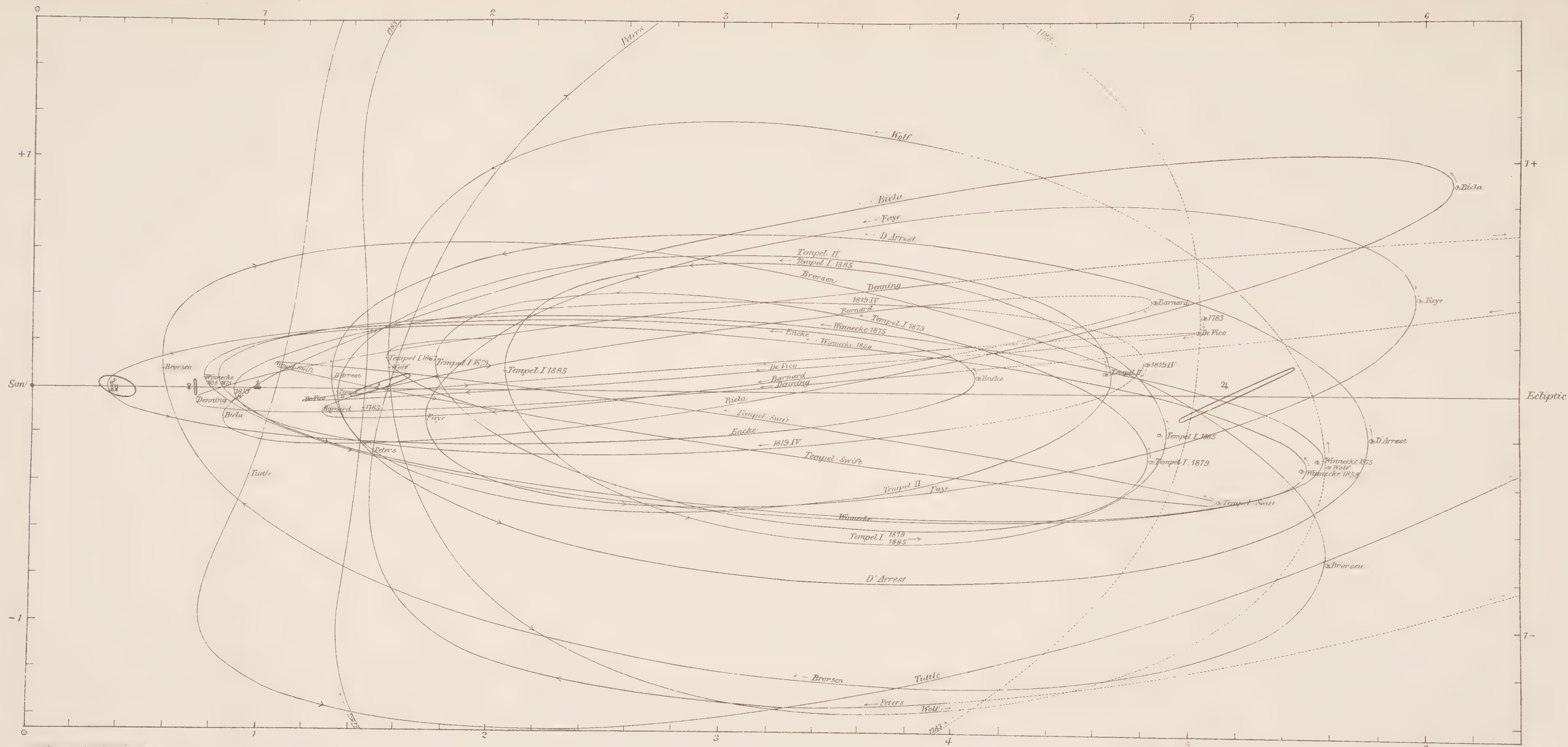
	R.A.			Decl.			
	h	m	s	°	'	"	
1800	17	3	26.21	-10	22	10.9	LL. 31188
1824			26.57			15.6	W.B. 1 3
1850			26.43			15.1	Lam, 2067
1850			26.25			16.0	Rad. Obs. 5, 2
1860			26.40			14.4	Sant. 1899, 2 Obs.
1884			26.42			19.4	Greenwich, 3 Obs.

By the method of least squares the Annual Proper Motion appears to be

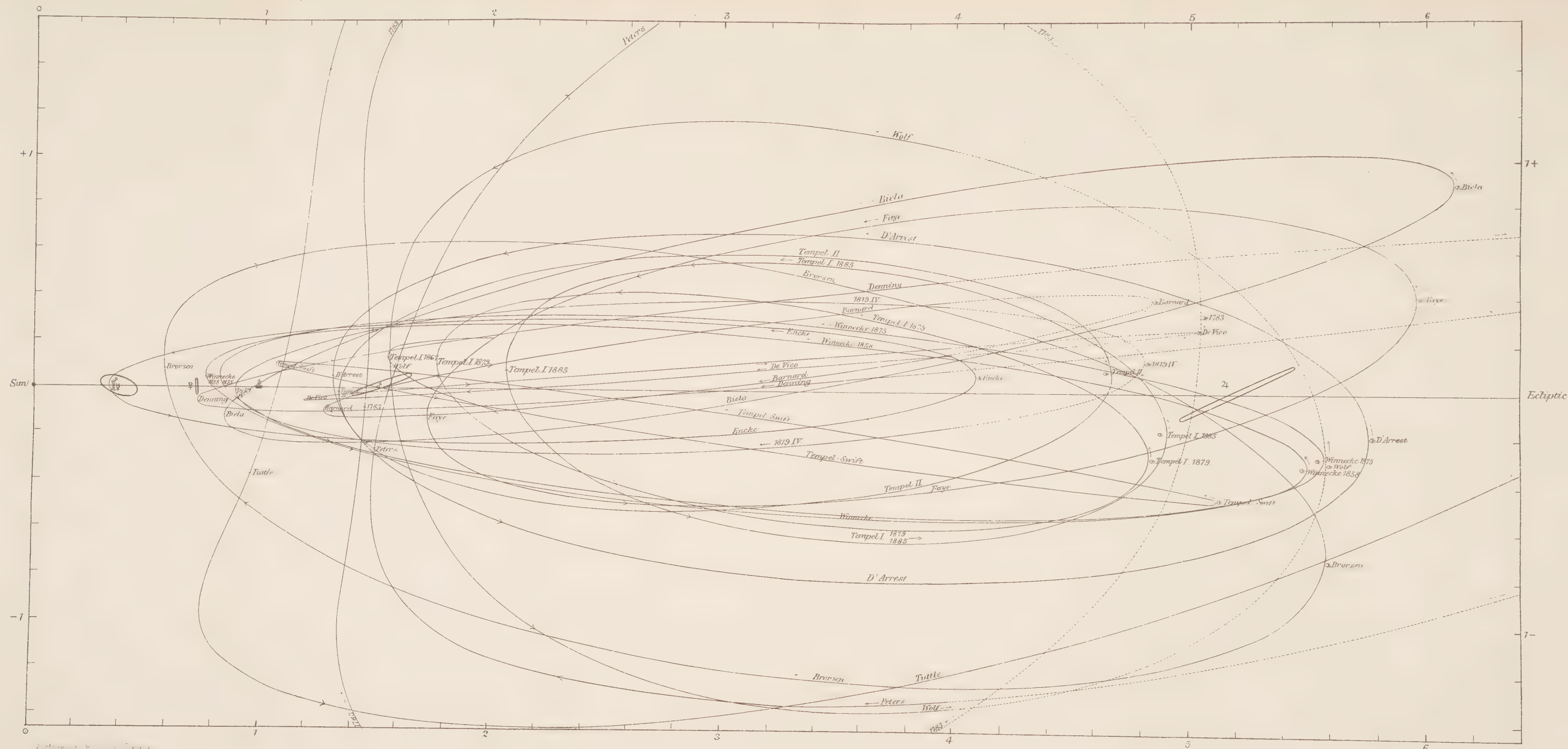
in R.A. 0.000

in Decl. -0".108.]

* W.B., No. 58 is evidently another observation of No. 83. There is no star in the place of No. 58.



Ecliptical Intersects of cometary orbits of short periods.



Ecliptical Intersects of cometary orbits of short periods.

Data for a Graphical Representation of the Solar System.
By A. Marth.

(Continued from p. 373.)

On account of the variety of the intersects of cometary orbits, and of the consequent inequalities in the number and distribution of the points, of which the co-ordinates are given, the succession of the groups of orbits cannot well be arranged in chronological order, but has to be made so as to keep orbits of similar type or of cognate character, as far as feasible, together. The order in which the following list is arranged will be easily recognised and appreciated by those who make practical use of it. The periodical comets of short or moderate periods are found in the first nine groups; group 10 contains the three principal comets moving in meteoric tracks, and then follow groups of comets of kindred type, beginning with those which approach nearest to the Sun, and ending with the comet of 1729. Though, in the case of those comets, the periodicity of which is determined from the observations of only one apparition, the uncertainty of the more distant parts of their tracks is considerable, it is of interest to learn something of their approaches to the orbits of the great planets, and the co-ordinates for these parts are therefore not omitted, it being understood that in some cases, as, for instance, in that of the Comet 1881 V., discovered by Denning, the portion extending beyond the orbit of *Jupiter* may be found, on the return of the comet, to require considerable corrections. Even in some well-determined orbits the data for the more distant parts are somewhat uncertain, simply because they are founded upon the published elements, which are valid only for the epoch for which they are given, and the changes of which cannot be taken into account as they are unpublished. The effect of these changes after a number of years may be seen in the case of Winnecke's and of Tempel's first periodical comet by laying down the intersects for the two revolutions, for which the data are contained in the list. As the changes of the orbit of Tempel's comet have been very remarkable, it will be of special interest to compare also the intersect of part of the orbit described at the comet's first appearance in 1867, and I give therefore the co-ordinates derived from Sandberg's elements (*Astr. Nachr.* 74, 103):—

φ	l	$r \cos b$	$r \sin b$	φ	l	$r \cos b$	$r \sin b$
-70	166°02	2°000	+0°203	0	236°34	1°559	+0°123
60	176°07	1°870	°203	+10	246°32	1°568	°101
50	186°13	1°767	°198	20	256°29	1°594	°075
40	196°19	1°687	°189	30	266°25	1°637	°047
30	206°25	1°628	°177	40	276°19	1°698	0°017
20	216°29	1°588	°162	50	286°13	1°778	-0°017
10	226°22	1°565	°144	60	296°07	1°880	°054
0	236°34	1°559	0°123	70	306°02	2°008	0°095

The changes in the intersect of Encke's comet are very moderate, as will be seen by comparison of a few of the co-ordinates of the orbit, which the comet described in 1819, with the corresponding one of 1885 given in the list:—

v	l	$r \cos b$	$r \sin b$	v	l	$r \cos b$	$r \sin b$
—180	336° 92	4·093	+0·041	0	156° 92	0·335	—0·003
150	6° 25	2·319	0·295	90	247° 06	0·602	0·146
120	36° 31	1·053	0·225	120	277° 73	1·055	0·214
90	67° 06	0·602	0·146	150	307° 65	2·324	0·255

In the list of co-ordinates the designation of a comet and the name of its first discoverer (if the discovery was a telescopic one) in the first line is followed in the second line by the name of the computer, whose determination of the elements has been used, and by a statement of the epoch, to the ecliptic and equinox of which the co-ordinates are referred. The following are the sources from which the elements have been taken. Where no reference is given the elements are those of Galle's list in the third edition of Olbers's *Abhandlung*. The numbers in brackets [] indicate the group in the list of co-ordinates in which the comet is to be found. The twelve periodical comets, which have unquestionably been observed at different returns to perihelion, arranged in the order in which their periodicity was fully proved, are given first, and are then followed by the rest arranged in chronological order.

♄ Halley [8], *Astron. Nachr.*, 25, 189. Encke [1], *Bulletin astron.*, 1, 536. Biela [2], *A. N.*, 63, 297. Faye [3], *Berliner Astr. Jahrbuch* 1882, p. [138]. Brorsen [3], *A. N.*, 95, 70. D'Arrest [3], *A. N.*, 105, 82. Tuttle [7], *Vierteljahrsschrift der Astr. Ges.*, 6, 100. Winnecke [2], *A. N.*, 97, 337. Tempel I. [4], *A. N.*, 95, 79, and *Nature*, 31, 468. Tempel II. [5], *A. N.*, 106, 221. Tempel-Swift [4], *Annuaire des Longitudes*, 1885, 218. Pons-Brooks [8], *A. N.*, 108, 16.

♄ 1770, I. [6], *A. N.*, 19, 165. 1783 [5], Galle. 1815 [8], *Vjtschrsft. d. Astr. Ges.*, 17, 113. 1819, IV., *Berliner Astr. Jahrbuch*, 1824, 220. 1844, I. [6]. 1846, IV. [9]. 1846, VI. [7]. 1847, V. [9], *A. N.*, 28, 222. 1852, IV. [9], *A. N.*, 49, 356. 1861, I. [10], *A. N.*, 62, 187. 1862, III. [10], *A. N.*, 69, 87. 1866, I. [10], *A. N.*, 68, 249. 1867, I. [7], *A. N.*, 69, 111. 1881, V. [1], *A. N.*, 105, 111. 1884, II. [6], *A. N.*, 111, 15. 1884, III. [5], *A. N.*, 110, 207.

A copy of the intersect-data for the orbits of sixty-seven other comets, and of the outer planets *Saturn*, *Uranus*, and *Neptune*, is in the library of the Astronomical Society.

GROUP I.

Encke's $\mathcal{E}$.—1885. Backlund.—Eq. 85°0.				$\mathcal{E}$ 1819, IV., Blanpain. Encke.—Eq. 20°0.			$\mathcal{E}$ 1881, V., Denning. W. Plummer.—Eq. 81°0.		
ν	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
-180	338°45	4°096 + 0°063		247°43	4°804 + 0°130		198°81	7°805 + 0°685	
175	343°32	4°011	°139	252°37	4°766	°064	203°81	7°667	°616
170	348°21	3°776	°203				208°80	7°274	°526
165	353°10	3°443	°250	262°25	4°472 - 0°062		213°79	6°701	°427
160	358°01	3°066	°279				218°77	6°040	°330
155	2°93	2°691	°292				223°75	5°366	°242
150	7°87	2°343	°294	277°08	3°710	°200	228°72	4°729	°167
145	12°83	2°037	°289				233°69	4°154	°105
140	17°82	1°773	°278				238°65	3°651	°055
135	22°82	1°550	°265	291°98	2°915	°264	243°62	3°219	°015
130	27°85	1°362	°250				248°58	2°850 - 0°016	
120	37°96	1°073	°220	306°96	2°276	°276	258°52	2°271	°060
110	48°15	0°868	°191	317°00	1°949	°267	268°46	1°854	°085
100	58°39	0°722	°164	327°08	1°691	°252	278°42	1°549	°100
90	68°65	0°616	°141	337°19	1°487	°233	288°40	1°324	°107
80	78°89	0°538	°119	347°31	1°328	°211	298°41	1°156	°110
70	89°09	0°480	°100	357°44	1°205	°188	308°44	1°029	°110
60	99°23	0°436	°082	7°54	1°108	°165	318°49	0°933	°107
45	114°27	0°391	°058	22°65	1°005	°130	333°59	0°851	°100
30	129°12	0°363	°036	37°66	0°939	°095	348°69	0°768	°090
15	143°82	0°347 + 0°015		52°58	0°903	°060	3°77	0°733	°078
0	158°45	0°342 - 0°005		67°43	0°892 - 0°024		18°81	0°723	°063
+ 15	173°10	0°348	°025	82°25	0°905 + 0°013		33°79	0°736	°047
30	187°87	0°362	°045	97°08	0°943	°051	48°72	0°772	°027
45	202°82	0°390	°067	111°98	1°009	°091	63°62	0°837	°004
60	217°96	0°435	°089	126°96	1°113	°135	78°52	0°939 + 0°025	
70	228°15	0°479	°105	137°00	1°208	°166	88°46	1°034	°048
80	238°39	0°537	°122	147°08	1°330	°198	98°42	1°159	°075
90	248°65	0°616	°141	157°19	1°487	°233	108°40	1°324	0°107
100	258°89	0°723	°160	167°31	1°688	°268	118°41	1°546	°147
110	269°09	0°870	°181	177°44	1°944	°304	128°44	1°845	°196
120	279°23	1°076	°203	187°54	2°268	°338	138°49	2°257	°258
130	289°28	1°367	°223				148°55	2°830	°33
+ 135	294°27	1°555 - 0°231		202°65	2°903 + 0°376		153°59	3°196 + 0°383	

GROUP I—continued.

Encke's $\mathcal{E}$.—1885. Backlund.—Eq. 85.0.				$\mathcal{E}$ 1819, IV., Blanpain. Encke.—Eq. 20.0.				$\mathcal{E}$ 1881, V., Denning. W. Plummer.—Eq. 81.0.			
v	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
+ 140	299 ⁰ 24	1.779	0.236					158 ⁰ 62	3.626	0.434	
145	304.19	2.043	.237					163.66	4.127	.490	
150	309.12	2.350	.232	217.66	3.696	0.374		168.69	4.699	.550	
155	314.03	2.706	.217					173.72	5.337	.609	
160	318.93	3.073	.190					178.75	6.013	.664	
165	323.82	3.452	.148	232.58	4.462	.295		183.77	6.678	.708	
170	328.70	3.781	.089					188.79	7.257	.731	
175	333.57	4.013	.017	242.49	4.762	.192		193.80	7.658	.724	
+ 180	348.45	4.096	0.063	247.43	4.804	0.130		198.81	7.805	0.685	

GROUP 2.

Biela's $\mathcal{E}$.—1852. Santini.—Eq. 52.74.				1858, Winnecke's $\mathcal{E}$. Eq. 58.0—Oppolzer.				1875. Eq. 80.0.			
v	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
- 180	288 ⁰ 45	6.121	0.922	95 ⁰ 95	5.495	0.317		96 ⁰ 97	5.565	0.280	
175	293.45	6.037	0.992	100.87	5.436	.227		101.89	5.509	.185	
170	298.47	5.821	1.030	105.79	5.257	.135		106.79	5.340	.089	
165	303.51	5.502	1.035	110.70	4.981	0.047		111.70	5.077	0.002	
160	308.58	5.115	1.012	115.61	4.642	0.032		116.60	4.752	.083	
155	313.66	4.697	0.968	120.52	4.271	.099		121.51	4.392	.151	
150	318.75	4.277	.910	125.44	3.894	.153		126.42	4.023	.206	
145	323.86	3.874	.844	130.36	3.530	.195		131.34	3.664	.247	
140	328.97	3.502	.774	135.29	3.192	.226		136.27	3.327	.277	
135	334.10	3.165	.705	140.23	2.884	.247		141.22	3.017	.298	
130	339.22	2.866	.637	145.19	2.608	.261		146.17	2.738	.310	
125	344.34	2.602	.573	150.16	2.365	.269		151.15	2.490	.317	
120	349.45	2.371	.513	155.14	2.150	.272		156.14	2.270	.318	
110	359.65	1.994	.406	165.15	1.799	.269		166.17	1.908	.310	
100	9.78	1.708	.316	175.22	1.531	.257		176.27	1.630	.294	
90	19.83	1.490	.239	185.35	1.328	.241		186.42	1.417	.273	
80	29.80	1.322	.173	195.51	1.172	.221		196.60	1.254	.249	
70	39.69	1.193	.117	205.69	1.054	.201		206.80	1.129	.224	
60	49.52	1.093	.069	215.86	0.963	.180		216.98	1.034	.199	
- 50	59.30	1.015	0.026	226.01	0.895	0.158		227.13	0.962	0.173	

GROUP 2—continued.

ϑ	Biela's  —1852. Santini.—Eq. 52.74.			1858, Eq. 58.0.—			Winnecke's  . Oppolzer.			1875. Eq. 80.0.		
	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
— 40	69°06	0.955	—0.012	236°11	0.844	+0.136	237°23	0.909	+0.147			
30	78.83	0.911	.045	246.16	0.808	.113	247.26	0.871	.121			
20	88.64	0.879	.076	256.14	0.784	.091	257.22	0.845	.095			
10	98.50	0.859	.103	266.07	0.771	.068	267.12	0.832	.069			
0	108.45	0.850	.128	275.95	0.768	.044	276.97	0.828	.042			
+ 10	118.47	0.852	.151	285.79	0.774	.020	286.79	0.834	.014			
20	128.58	0.865	.171	295.61	0.789	—0.005	296.60	0.851	—0.015			
30	138.75	0.892	.190	305.44	0.815	.032	306.42	0.878	.045			
40	148.97	0.933	.206	315.29	0.853	.060	316.27	0.917	.077			
50	159.22	0.991	.220	325.19	0.904	.091	326.17	0.971	.110			
60	169.45	1.070	.232	335.14	0.972	.123	336.14	1.043	.146			
70	179.65	1.175	.239	345.15	1.061	.159	346.17	1.136	.185			
80	189.78	1.311	.242	355.22	1.177	.198	356.27	1.258	.227			
90	199.83	1.490	.239	5.35	1.328	—0.241	6.42	1.417	.273			
100	209.80	1.722	.226	15.51	1.526	.288	16.60	1.625	.323			
110	219.69	2.025	.199	25.69	1.787	.341	26.80	1.896	.377			
120	229.52	2.421	.152	35.86	2.131	.397	36.98	2.251	.433			
125	234.41	2.662	.118	40.94	2.341	.426	42.06	2.467	.461			
130	239.30	2.935	.075	46.01	2.581	.455	47.13	2.712	.488			
135	244.18	3.243	.021	51.07	2.854	.483	52.19	2.988	.513			
140	249.06	3.586	+0.044	56.11	3.159	.508	57.23	3.295	.534			
145	253.94	3.963	.124	61.14	3.496	.528	62.25	3.631	.549			
150	258.83	4.367	.218	66.16	3.859	.542	67.26	3.990	.556			
155	263.73	4.785	.327	71.16	4.237	.545	72.25	4.360	.551			
160	268.64	5.195	.448	76.14	4.611	.534	77.22	4.723	.532			
165	273.56	5.568	.576	81.11	4.956	.507	82.18	5.053	.495			
170	278.50	5.869	.705	86.07	5.238	.461	87.12	5.322	.439			
175	283.46	6.062	.823	91.01	5.426	.396	92.05	5.500	.366			
+ 180	288.45	6.121	+0.922	95.95	5.495	—0.317	96.97	5.565	—0.280			

GROUP 3.

Brorsen's  .—1879. Schulze, cor. by Harzer.—Eq. 79°0.				D'Arrest's  .—1877. Leveau.—Eq. 80°0.			Faye's  .—1881. Möller.—Eq. 80°0.		
ϕ	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
— 180	294°39	5°568	—0°709	140°80	5°747	—0°190	230°43	5°955	+0°424
175	298°85	5°446	0°923	144°24	5°728	°054	236°37	5°920	°516
170	303°36	5°158	1°090	149°05	5°620	+0°080	240°31	5°847	°598
165	307°95	4°753	1°199	153°87	5°448	°206	245°27	5°694	°665
160	312°63	4°287	1°254	158°69	5°223	°319	250°25	5°515	°720
155	317°42	3°808	1°263	163°53	4°961	°417	255°25	5°305	°760
150	322°31	3°353	1°238	168°39	4°677	°498	260°26	5°072	°786
145	327°32	2°939	1°190	173°27	4°383	°562	265°29	4°827	°799
140	332°45	2°575	1°129	178°17	4°088	°610	270°33	4°577	°800
135	337°71	2°262	1°060	183°11	3°804	°644	275°39	4°329	°791
130	342°98	1°995	0°989	188°07	3°535	°665	280°46	4°088	°774
125	348°56	1°769	°919	193°07	3°284	°675	285°55	3°858	°750
120	354°14	1°580	°850	198°11	3°053	°677	290°64	3°641	°720
115	359°79	1°421	°784	203°17	2°842	°671	295°73	3°438	°687
110	5°50	1°288	°721	208°27	2°651	°660	300°83	3°250	°651
100	16°96	1°084	°607	218°54	2°326	°624	311°03	2°920	°573
90	28°32	0°940	°506	228°90	2°067	°577	321°19	2°647	°493
80	39°39	0°838	°416	239°28	1°863	°523	331°31	2°423	°413
70	50°02	0°765	°336	249°65	1°704	°466	341°37	2°242	°335
60	60°17	0°713	°264	259°96	1°581	°407	351°36	2°096	°260
50	69°85	0°674	°198	270°17	1°489	°347	1°28	1°981	°188
40	79°13	0°644	°137	280°26	1°420	°287	11°15	1°892	°120
30	88°11	0°622	°080	290°21	1°371	°227	20°98	1°824	°055
20	96°89	0°606	°026	300°04	1°339	°166	30°79	1°776	—0°007
10	105°61	0°593	+0°025	309°77	1°322	°105	40°60	1°745	°067
0	114°39	0°585	°075	320°80	1°314	°043	50°43	1°734	°124
+ 10	123°36	0°581	°123	329°05	1°326	—0°019	60°31	1°737	°178
20	132°63	0°582	°170	338°69	1°347	°082	70°25	1°761	°230
30	142°31	0°589	°217	348°39	1°382	°147	80°26	1°803	°279
40	152°45	0°603	°264	358°17	1°433	°214	90°33	1°867	°326
50	162°98	0°629	°312	8°07	1°502	°283	100°46	1°955	°370
60	174°14	0°669	°360	18°11	1°594	°353	110°64	2°072	°410
+ 70	185°50	0°729	+0°409	28°27	1°714	—0°426	120°83	2°223	—0°445

GROUP 3—continued.

Brorsen's .—1879. Schulze, cor. by Harzer.—Eq. 79°0.				D'Arrest's .—1877. Leveau.—Eq. 80°0.			Faye's .—1881. Möller.—Eq. 80°0.		
<i>v</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>
+ 80	196°96	0·817	+0·457	38°54	1·869	-0·501	131°03	2·412	-0·474
90	208°32	0·940	·506	48°90	2·067	·577	141°19	2·647	·493
100	219°39	1·113	·553	59°28	2·318	·652	151°31	2·934	·500
110	230°02	1·352	·594	69°65	2·635	·721	161°37	3·279	·490
115	235°17	1·504	·611	74°81	2·822	·753	166°37	3·473	·476
120	240°17	1·682	·623	79°96	3·028	·780	171°36	3·683	·457
125	245°07	1·892	·630	85°08	3·256	·802	176°33	3·906	·429
130	249°85	2·136	·628	90°17	3·503	·817	181°28	4·142	·393
135	254°45	2·421	·614	95°23	3·770	·824	186°22	4·387	·349
140	259°13	2·750	·585	100°26	4·046	·819	191°15	4·637	·294
145	263°65	3·126	·534	105°24	4·345	·801	196°07	4·887	·229
150	268°11	3·545	·456	110°21	4·640	·767	200°98	5·131	·154
155	272°52	3·998	·345	115°14	4·949	·715	205°88	5·358	·069
160	276°89	4·462	·194	120°04	5·193	·643	210°79	5·562	+0·023
165	281°25	4·902	·003	124°91	5·423	·553	215°69	5·731	·122
170	285°61	5·267	-0·222	129°77	5·603	·445	220°60	5·874	·225
175	289°99	5·504	·467	134°60	5·719	·322	225°51	5·934	·326
+ 180	294°39	5·568	-0·709	140°80	5·747	-0·190	230°43	5·955	+0·424

GROUP 4.

Tempel-Swift, 1880. Schulhof & Bossert.—Eq. 80°0.				1879. Eq. 79°0.			Tempel I. Gautier.			1885. —Eq. 85°0.	
<i>v</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>		
-180	223°15	5·103	-0·462	58°47	4·812	-0·288	61°63	4·894	-0·176		
175	228°16	5·068	·445	63°41	4·800	·219	66°54	4·884	·097		
170	233°18	4·962	·419	68°34	4·756	·148	71°45	4·847	·016		
165	238°19	4·797	·386	73°27	4·683	·077	76°36	4·786	+0·062		
160	243°20	4·584	·348	78°20	4·583	·008	81°28	4·702	·138		
155	248°20	4·338	·307	83°13	4·460	+0·058	86°19	4·599	·209		
150	253°21	4·075	·265	88°06	4·320	·120	91°12	4·479	·274		
140	263°19	3·542	·185	97°93	4·005	·227	101°00	4·207	·385		
130	273°17	3·049	·115	107°83	3·673	·307	110°93	3·911	·466		
-120	283°14	2·626	-0·059	117°78	3·349	+0·363	120°92	3·616	+0·518		

GROUP 4—continued.

Temple-Swift, 1880. Schulhof & Bossert.—Eq. 80°0.				1879, Eq. 79°0.			Tempel I. Gautier.			1885. —Eq. 85°0.		
ν	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
— 110	293°09	2'276	—0'014	127°78	3'050	+0'397	130°98	3'338	+0'545			
100	303°05	1'993	+0'020	137°82	2'785	'412	141°09	3'085	'550			
90	313°01	1'766	'046	147°91	2'556	'412	151°24	2'863	'538			
80	322°98	1'584	'066	158°04	2'362	'400	161°41	2'673	'512			
70	332°96	1'441	'080	168°18	2'202	'379	171°59	2'514	'475			
60	342°95	1'327	'090	178°33	2'072	'352	181°75	2'384	'431			
50	352°96	1'239	'097	188°46	1'969	'319	191°83	2'280	'380			
40	2°98	1'172	'101	198°55	1'890	'283	201°94	2'199	'325			
30	13°02	1'122	'103	208°60	1'832	'242	211°94	2'140	'266			
20	23°06	1'088	'102	218°60	1'793	'199	221°89	2'100	'205			
10	33°10	1'069	'100	228°56	1'771	'154	231°78	2'078	'141			
0	43°15	1'063	'096	238°47	1'766	'106	241°63	2'072	'075			
+ 10	53°18	1'070	'090	248°34	1'777	'055	251°45	2'082	'007			
20	63°20	1'090	'083	258°20	1'804	'003	261°28	2'109	—0'062			
30	73°21	1'124	'073	268°06	1'847	—0'051	271°12	2'152	'132			
40	83°19	1'174	'061	277°93	1'908	'108	281°00	2'214	'203			
50	93°17	1'242	'047	287°83	1'988	'166	290°93	2'295	'273			
60	103°14	1'330	'030	297°78	2'090	'227	300°92	2'398	'344			
70	113°09	1'443	'009	307°78	2'216	'288	310°98	2'525	'412			
80	123°05	1'586	—0'016	317°82	2'370	'350	321°09	2'680	'478			
90	133°01	1'766	'046	327°91	2'556	'412	331°24	2'863	'538			
100	142°98	1'991	'083	338°04	2'776	'470	341°41	3'078	'589			
110	152°96	2'273	'126	348°18	3'031	'522	351°59	3'323	'628			
120	162°95	2'621	'178	358°33	3'321	'564	1°75	3'595	'650			
130	172°96	3'042	'238	8°46	3'638	'590	11°83	3'885	'648			
140	182°98	3'533	'304	18°55	3'968	'593	21°94	4'179	'618			
150	193°02	4'067	'372	28°60	4'284	'567	31°94	4'454	'554			
155	198°04	4'330	'403	33°61	4'427	'541	36°92	4'575	'509			
160	203°06	4'577	'430	38°60	4'555	'506	41°89	4'682	'456			
165	208°08	4'791	'451	43°59	4'660	'463	46°84	4'770	'395			
170	213°10	4'958	'464	48°56	4'741	'411	51°78	4'836	'327			
175	218°13	5'066	'468	53°52	4'792	'352	56°71	4'878	'254			
+ 180	223°15	5'103	—0'462	58°47	4'812	—0'288	61°63	4'894	—0'176			

GROUP 5.

Tempel II., 1883. Schulhof.—Eq. 80°0.				1783, Pigott. Peters.—Eq. 1783°0.			1884, III., Wolf. Krüger.—Eq. 84°0.		
ϑ	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
—180	125°99	4°665	+0°091	231°87	5°051	+0°337	199°75	5°564	—0°303
175	130°87	4°640	°179	235°40	5°038	0°024			
170	135°76	4°572	°263	238°94	4°961	—0°283	208°80	5°466	+0°109
165	140°66	4°464	°339	242°49	4°823	0°575			
160	145°57	4°323	°406	246°10	4°635	0°842	217°88	5°153	0°485
155	150°50	4°156	°463	249°79	4°407	1°079			
150	155°45	3°971	°508	253°59	4°150	1°282	227°08	4°696	0°783
140	165°40	3°575	°566	261°65	3°596	1°581	236°50	4°179	0°989
130	175°44	3°184	°586	270°52	3°047	1°748	246°20	3°667	1°108
120	185°57	2°826	°578	280°49	2°555	1°808	256°25	3°204	1°155
110	195°76	2°515	°549	291°76	2°146	1°788	266°64	2°807	1°150
100	205°99	2°253	°508	304°37	1°830	1°712	277°35	2°481	1°106
90	216°25	2°037	°459	318°07	1°606	1°598	288°29	2°222	1°038
80	226°48	1°861	°406	332°20	1°464	1°460	299°34	2°022	0°952
70	236°67	1°720	°351	345°96	1°387	1°306	310°34	1°871	0°857
60	246°79	1°609	°296	358°67	1°358	1°143	321°17	1°761	0°754
50	256°83	1°522	°240	10°04	1°357	0°975	331°72	1°683	0°647
40	266°80	1°455	°185	20°10	1°375	0°803	341°93	1°629	0°538
30	276°66	1°406	°131	29°05	1°397	0°629	351°79	1°595	0°427
20	286°46	1°372	°078	37°16	1°421	0°453	1°33	1°576	0°315
10	296°24	1°352	°026	44°69	1°441	0°276	10°62	1°568	0°201
0	305°99	1°344	—0°026	51°87	1°456	0°097	19°75	1°570	0°085
+10	315°76	1°350	°078	58°94	1°465	+0°084	28°80	1°580	—0°032
20	325°57	1°368	°129	66°10	1°467	0°267	37°88	1°600	0°150
30	335°45	1°401	°179	73°59	1°464	0°452	47°08	1°629	0°272
40	345°40	1°449	°229	81°65	1°457	0°641	56°50	1°670	0°395
50	355°44	1°515	°279	90°52	1°450	0°832	66°20	1°726	0°521
60	5°57	1°603	°328	100°49	1°449	1°025	76°25	1°802	0°650
70	15°76	1°715	°375	111°76	1°464	1°220	86°64	1°904	0°780
80	25°99	1°858	°419	124°37	1°510	1°412	97°35	2°041	0°910
90	36°25	2°037	°459	138°07	1°606	1°598	108°29	2°222	1°038
100	46°48	2°256	°492	152°20	1°815	1°770	119°34	2°457	1°157
110	56°67	2°522	°515	165°96	2°033	1°915	130°34	2°758	1°262
+120	66°79	2°837	—0°521	178°67	2°394	+2°016	141°17	3°131	—1°341

GROUP 5—continued.

Tempel II., 1883. Schulhof.—Eq. 80°0.				1783, Pigott. Peters.—Eq. 1783°0.				1884, III., Wolf. Krüger.—Eq. 84°0.			
ν	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
+ 130	76°83	3°198	-0°505	190°04	2°854	+2°048		151°72	3°576	-1°376	
140	86°80	3°591	°457	200°10	3°392	1°981		161°93	4°077	1°347	
150	96°66	3°986	°372	209°05	3°961	1°782		171°79	4°599	1°231	
155	101°57	4°170	°315	213°20	4°236	1°626					
160	106°46	4°335	°247	217°16	4°489	1°431		181°33	5°075	1°013	
165	111°36	4°474	°170	220°98	4°707	1°199					
170	116°24	4°579	°087	224°69	4°880	0°934		190°60	5°423	0°694	
175	121°12	4°644	+0°001	228°31	4°997	0°644					
+ 180	125°99	4°665	+0°091	231°87	5°051	+0°337		199°75	5°564	-0°303	

GROUP 6.

1770, I. Clausen.—Eq. 1770°75.				1844, I., De Vico. Brünnow.—Eq. 1844°66.				1884, II., Barnard. Berberich.—Eq. 84°0.			
ν	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
- 180	176°28	5°631	+0°108	162°52	5°008	+0°252		126°29	4°832	+0°395	
175	181°28	5°553	°116	167°53	4°978	°246		131°30	4°809	°371	
170	186°28	5°333	°119	172°54	4°889	°236		136°31	4°736	°341	
165	191°28	5°004	°118	177°54	4°748	°221		141°31	4°618	°306	
160	196°28	4°609	°114	182°54	4°565	°204		146°30	4°464	°268	
155	201°28	4°188	°108	187°55	4°352	°184		151°30	4°282	°228	
150	206°28	3°773	°100	192°55	4°120	°164		156°29	4°081	°188	
145	211°28	3°382	°091	197°55	3°379	°143		161°27	3°869	°150	
140	216°29	3°027	°083	202°55	3°638	°122		166°26	3°654	°113	
135	221°29	2°711	°075	207°55	3°404	°102		171°24	3°441	°079	
130	226°29	2°434	°067	212°55	3°180	°084		176°22	3°236	°048	
120	236°29	1°984	°053	222°54	2°775	°051		186°17	2°856	-0°005	
110	246°30	1°647	°041	232°53	2°432	°024		196°13	2°528	°046	
100	256°30	1°395	°032	242°51	2°149	°002		206°09	2°251	°077	
90	266°30	1°204	°024	252°50	1°919	-0°015		216°06	2°022	°099	
80	276°30	1°060	°017	262°49	1°733	°028		226°05	1°835	°115	
70	286°30	0°949	°011	272°48	1°584	°039		236°05	1°684	°125	
60	296°29	0°865	°006	282°48	1°465	°047		246°07	1°562	°130	
45	311°29	0°774	°000	297°48	1°335	°055		261°12	1°428	°132	
- 30	326°28	0°717	-0°005	312°49	1°249	-0°059		276°18	1°340	-0°128	

GROUP 6—continued.

v	☾ 1770, I. Clausen.—Eq. 1770·75.			☾ 1844, I., De Vico. Brünnow.—Eq. 1844·66.			☾ 1884, II., Barnard. Berberich.—Eq. 84·0		
	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
-15	341°28	0·685	-0·009	327°51	1·200	-0·061	291°25	1·290	-0·118
0	356°28	0·674	·013	342°52	1·185	·060	306°29	1·275	·104
+15	11°28	0·685	·016	357°54	1·201	·056	321°31	1·293	·086
30	26°28	0·716	·019	12°55	1·249	·050	336°29	1·344	·062
45	41°29	0·774	·021	27°55	1·335	·040	351°24	1·434	·033
60	56°29	0·864	·023	42°54	1·466	·027	6°17	1·568	+0·003
70	66°30	0·949	·024	52°53	1·584	·016	16°13	1·688	·031
80	76°30	1·060	·024	62°51	1·733	·002	26°09	1·837	·063
90	86°30	1·204	·024	72°50	1·919	+0·015	36°06	2·022	+0·099
100	96°30	1·395	·022	82°49	2·149	·035	46°05	2·248	·140
110	106°30	1·648	·020	92°48	2·432	·059	56°05	2·521	·187
120	116°29	1·985	·015	102°48	2·774	·088	66°07	2·846	·237
130	126°29	2·435	·007	112°48	3·179	·121	76°10	3·223	·291
135	131°29	2·712	·001	117°48	3·402	·139	81°12	3·427	·317
140	136°29	3·028	+0·006	122°48	3·637	·158	86°14	3·639	·343
145	141°28	3·383	·015	127°48	3·878	·177	91°16	3·854	·367
150	146°28	3·774	·026	132°49	4·119	·195	96°18	4·067	·388
155	151°28	4·189	·038	137°49	4·351	·213	101°20	4·269	·405
160	156°28	4·610	·052	142°50	4·564	·228	106°23	4·453	·417
165	161°28	5·005	·067	147°51	4·747	·240	111°25	4·609	·423
170	166°28	5·334	·083	152°51	4·888	·249	116°26	4·729	·421
175	171°28	5·554	·097	157°52	4·978	·253	121°28	4·805	·412
+180	176°28	5·631	+0·108	162°52	5·008	+0·252	126°29	4·832	+0·395

GROUP 7.

v	☾ Tuttle.—1858. Tischler.—Eq. 58·0.			☾ 1846, VI., Peters. Peters.—Eq. 46·0.			☾ 1867, I., Coggia. Searle.—Eq. 67·0.		
	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
-180	285°43	9·717	+3·829	62°74	9·295	+1·663	256°01	19·261	+0·286
175	288°89	9·275	4·398	67°16	9·266	1·254	260°76	18·858	-0·234
170	292°91	8·527	4·756	71°53	9·048	0·827	265°51	17·732	0·702
165	296°54	7·590	4·895	75°86	8·667	0·410	270°27	16·129	1·074
160	300°84	6·588	4·849	80°17	8·168	0·026	275°05	14·321	1·335
155	305°54	5·617	4·667	84°49	7·593	-0·311			
-150	310°70	4·739	+4·400	88°82	6·985	-0·594	284°69	10·871	-1·573

GROUP 7—continued.

Tuttle.—1858. Tischler.—Eq. 58°0.				1846, VI., Peters. Peters.—Eq. 46°0.				1867, I., Coggia. Searle.—Eq. 67°0.			
v	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
—145	316°40	3'979	4'089	93°18	6'379	—0'823		°			
140	322°68	3'345	3'763	97°59	5'795	1'000	294'46	8°167	—1'574		
135	329°59	2'828	3'441	102°07	5'250	1'133					
130	337°10	2'417	3'132	106°63	4'750	1'228	304'40	6°230	1'504		
125	345°14	2'095	2'842	111°28	4'298	1'291					
120	353°56	1'850	2'573	116°03	3'895	1'329	314'52	4°875	1'328		
115	2°14	1'666	2'325	120°91	3'538	1'346					
110	11°63	1'532	2'097	125°91	3'223	1'347	324'80	3°924	1'181		
100	26°47	1'367	1'696	136°30	2'706	1'314	335°22	3°272	1'047		
90	40°00	1'285	1'356	147°20	2'316	1'249	345°73	2°762	0'908		
80	51°17	1'241	1'064	158°52	2'028	1'164	356°25	2°409	0'786		
70	60°39	1'211	0'812	170°07	1'820	1'068	6°72	2°151	0'672		
60	68°20	1'186	0'590	181°63	1'676	0'965	17°09	1°961	0'567		
50	75°04	1'158	0'392	192°96	1'580	0'857	27°30	1°822	0'468		
40	81°28	1'127	0'213	203°90	1'522	0'746	37°34	1°722	0'374		
30	87°19	1'090	0'050	214°33	1'491	0'631	47°20	1°651	0'283		
20	93°02	1'049	—0'101	224°24	1'482	0'514	56°90	1°605	0'195		
10	99°02	1'004	0'243	233°68	1'487	0'394	66°49	1°580	0'109		
0	105°43	0'954	0'376	242°74	1'505	0'269	76°01	1°572	0'023		
+10	112°91	0'902	0'503	251°53	1'532	0'140	85°51	1°582	+0'063		
20	120°84	0'849	0'625	260°17	1'568	—0'005	95°05	1°610	0'150		
30	130°70	0'800	0'743	268°82	1°614	+0'137	104°69	1°658	0'240		
40	142°68	0'762	0'857	277°59	1°670	0'288	114°46	1°730	0'333		
50	157°10	0'747	0'968	286°63	1°740	0'450	124°40	1°831	0'432		
60	172°56	0'773	1'075	296°03	1°830	0'624	134°52	1°969	0'537		
70	191°63	0'860	1'177	305°91	1°947	0'814	144°80	2°158	0'649		
80	206°47	1'026	1'273	316°30	2°104	1'021	155°22	2°413	0'772		
90	220°00	1'285	1'356	327°20	2°316	1'249	165°73	2°762	0'908		
100	231°17	1°653	1°418	338°52	2°609	1°498	176°25	3°266	1°065		
110	240°39	2°158	1°446	350°07	3°013	1°768	186°72	3°911	1°223		
115	244°44	2°472	1°439	355°86	3°268	1°910					
120	248°20	2°837	1°411	1°63	3°567	2°054	197°09	4°854	1°403		
125	251°72	3°260	1°357								
130	255°04	3°747	1°267	12°96	4°313	+2°339	207°30	6°200	+1°592		
+135	258°22	4°308	—1°131								

GROUP 7—continued.

Tuttle.—1858. Tischler.—Eq. 58°0.				1846, VI., Peters. Peters.—Eq. 46°0.				1867, I., Coggia, Searle.—Eq. 67°0.			
φ	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
+ 140	261°28	4°948	—0°935	23°90	5°281	+ 2°587		217°34	8°317	+ 1°763	
145	264°26	5°667	0°662								
150	267°19	6°460	0°294	34°33	6°457	2°733		227°20	10°827	1°856	
155	270°10	7°300	+ 0°186								
160	273°02	8°141	0°787	44°24	7°716	2°677		236°90	14°278	1°706	
165	275°98	8°905	1°502					241°71	16°091	1°538	
170	279°02	9°490	2°295	53°68	8°783	2°324		246°49	17°704	1°222	
175	282°15	9°786	3°100					251°25	18°842	0°792	
+ 180	285°43	9°717	+ 3°829	62°74	9°295	+ 1°663		256°01	19°261	+ 0°286	

GROUP 8.

Halley's $\mathcal{H}$.—1835. Westphalen.—Eq. 1835°87.				Pons—Brooks's $\mathcal{H}$.—1884. Schulhof & Bossert.—Eq. 80°0.				1815, Olbers, 1886. Ginzel.—Eq. 87°0.			
φ	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
— 180	123°59	33°918	—10°097	259°56	31°97	+ 10°65		321°67	25°70	—21°26	
175	118°42	30°575	8°740	261°14	28°66	12°26					
170	113°29	23°540	6°399	262°83	22°51	11°95		334°30	19°86	18°35	
165	108°19	17°050	4°361	264°67	16°46	10°56					
160	103°14	12°344	2°935	266°73	11°741	8°980		347°92	13°19	12°91	
155	98°13	9°148	1°996	269°06	8°370	7°558					
150	93°16	6°980	1°376	271°76	6°014	6°381		1°92	8°54	8°34	
145	88°23	5°477	0°957	274°96	4°361	5°430					
140	83°35	4°407	0°666	278°85	3°186	4°665		15°51	5°941	5°463	
135	78°49	3°623	0°459	283°71	2°339	4°042		21°95	5°103	4°460	
130	73°67	3°036	0°308	289°98	1°722	3°530		28°07	4°458	3°659	
125	68°87	2°585	0°196	298°25	1°274	3°103		33°87	3°954	3°011	
120	64°09	2°232	0°111	309°31	0°954	2°741		39°33	3°553	2°482	
110	54°56	1°725	+ 0°006	341°15	0°620	2°165		49°33	2°957	1°678	
100	45°02	1°385	0°078	14°57	0°572	1°726		58°25	2°534	1°105	
90	35°43	1°147	0°124	35°79	0°635	1°377		66°37	2°216	0°680	
80	25°74	0°976	0°154	47°89	0°707	1°092		73°93	1°963	0°356	
70	14°91	0°849	0°176	55°46	0°762	0°852		81°10	1°756	0°101	
60	5°90	0°756	0°183	60°74	0°799	0°645		88°30	1°579	+ 0°102	
45	350°59	0°658	0°190	66°52	0°822	0°379		99°28	1°356	0°340	
30	334°98	0°599	0°189	71°09	0°816	0°150		111°28	1°171	0°520	
— 15	319°25	0°568	+ 0°181	75°25	0°787	— 0°055		125°15	1°028	+ 0°659	

GROUP 8—continued.

Halley's $\mathcal{H}$.—1835. Pons-Brooks's $\mathcal{H}$.—1884. $\mathcal{H}$ 1815, Olbers, 1886.
Westphalen.—Eq. 1835'87. Schulhof & Bossert.—Eq. 80'0. Ginzel.—Eq. 87'0.

	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
— 0	303'59	0'562	+ 0'167	79'56	0'736	— 0'245	141'67	0'925	+ 0'765
+ 15	288'19	0'578	0'148	84'67	0'664	0'426	161'02	0'882	0'844
30	273'16	0'616	0'121	91'76	0'569	0'604	181'92	0'918	0'897
45	258'49	0'680	0'086	103'71	0'453	0'784	201'95	1'053	0'920
60	244'09	0'777	0'039	129'31	0'337	0'969	219'33	1'300	0'906
70	234'56	0'867	— 0'003	161'15	0'315	1'099	229'33	1'529	0'868
80	225'02	0'986	0'056	194'57	0'410	1'235	238'25	1'829	0'797
90	215'43	1'147	0'124	215'79	0'635	1'377	246'37	2'216	0'680
100	205'74	1'370	0'216	227'89	0'988	1'526	253'93	2'720	0'493
110	194'91	1'689	0'349	235'46	1'502	1'678	261'10	3'394	0'196
120	185'90	2'172	0'527	240'74	2'258	1'823	268'30	4'325	— 0'280
125	180'84	2'509	0'653	242'88	2'773	1'887	271'90	4'930	0'623
130	175'74	2'942	0'811	244'79	3'418	1'934	275'55	5'668	1'067
135	170'59	3'509	1'014	246'52	4'241	1'955	279'28	6'573	1'649
140	165'42	4'268	1'282	248'13	5'310	1'930	283'13	7'700	2'419
145	160'21	5'312	1'642	249'65	6'722	1'825			
150	154'98	6'785	2'140	251'09	8'625	1'581	291'28	10'91	4'84
155	149'74	8'920	2'847	252'50	11'224	1'098			
160	144'49	12'084	3'368	253'87	14'780	0'201	300'27	16'00	9'20
165	139'25	16'769	5'340	255'25	19'509	+ 1'374			
170	134'01	23'274	7'310	256'64	25'181	3'913	310'33	22'09	15'60
175	128'78	30'398	9'336	258'08	30'30	7'35			
+ 180	123'59	33'918	— 10'097	259'56	31'97	+ 10'65	321'67	25'70	— 21'26

GROUP 9.

$\mathcal{H}$ 1846, IV., De Vico.
Peirce.—Eq. 46'0.

$\mathcal{H}$ 1847, V., Brorsen.
D'Arrest.—Eq. 47'0.

1852, IV., Westphal.
Möller.—Eq. 52'0.

	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
— 180	258'68	33'63	— 7'67	270'84	34'26	— 7'49	215'57	24'57	— 16'17
175	259'14	29'94	9'63						
170	259'62	22'92	9'64						
165	260'14	16'33	8'61	285'45	15'725	2'252	232'99	16'63	13'25
160	260'72	11'43	7'36	290'25	11'104	1'290	239'27	13'49	11'18
155	261'36	8'052	6'232	295'03	8'085	0'716	245'72	10'89	9'28
150	262'09	5'742	5'300	299'78	6'090	0'368	252'29	8'868	7'670
145	262'95	4'142	4'546	304'51	4'731	0'152	258'90	7'323	6'338
140	264'00	3'008	3'937	309'24	3'774	0'013	265'49	6'150	5'258
— 135	265'31	2'186	— 3'440	313'96	3'080	+ 0'077	271'96	5'255	— 4'383

GROUP 9—continued.

1846, IV., De Vico. Peirce.—Eq. 46°0.				1847, V., Brorsen. D'Arrest.—Eq. 47°0.				1852, IV., Westphal. Müller.—Eq. 52°0.			
<i>v</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>		<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	
—130	267°03	1°577	—3°028	318°69	2°564	+0°137		278°28	4°566	—3°665	
125	269°43	1°118	2°683	323°44	2°169	0°177		284°38	4°028	3°076	
120	273°06	0°766	2°390	328°20	1°862	0°204		290°23	3°603	2°587	
110	291°97	0°291	1°919	337°83	1°423	0°252		301°15	2°981	1°827	
100	18°23	0°155	1°556	347°61	1°133	0°241		311°06	2°554	1°273	
90	47°11	0°310	1°265	357°58	0°932	0°240		320°08	2°241	0°854	
80	66°13	0°443	1°024	7°75	0°790	0°232		328°44	2°000	0°528	
70	70°04	0°537	0°820	18°11	0°687	0°222		336°32	1°805	0°267	
60	72°31	0°601	0°642	28°60	0°613	0°209		343°95	1°643	0°055	
45	74°49	0°657	0°410	44°46	0°539	0°186		355°35	1°440	+0°199	
30	76°05	0°679	0°208	60°25	0°497	0°162		7°28	1°275	0°398	
15	77°38	0°675	0°025	75°74	0°478	0°134		20°47	1°142	0°558	
0	78°68	0°647	+0°148	90°84	0°477	0°104		35°57	1°044	0°687	
+15	80°14	0°597	0°315	105°45	0°491	0°070		52°99	0°994	0°792	
30	82°09	0°522	0°482	119°78	0°521	0°032		72°29	1°011	0°874	
45	85°31	0°416	0°654	133°96	0°570	—0°014		91°96	1°117	0°932	
60	93°06	0°268	0°837	148°20	0°644	0°070		110°23	1°335	0°959	
70	111°97	0°147	0°969	157°83	0°713	0°116		121°15	1°556	0°954	
80	198°23	0°111	1°110	167°61	0°805	0°171		131°06	1°851	0°923	
90	227°11	0°310	1°265	177°58	0°932	0°240		140°08	2°241	0°854	
100	246°30	0°621	1°435	187°75	1°111	0°327		148°44	2°759	0°728	
110	250°04	1°064	1°624	198°11	1°372	0°443		156°32	3°459	0°512	
115	251°30	1°357	1°726	—	—	—		160°16	3°904	0°354	
120	252°31	1°716	1°832	208°60	1°773	0°604		163°95	4°432	0°149	
125	253°15	2°163	1°942	213°88	2°057	0°710		167°73	5°067	—0°120	
130	253°86	2°729	2°052	219°17	2°425	0°842		171°52	5°836	0°472	
135	254°49	3°457	2°158	224°46	2°912	1°007		175°35	6°777	0°937	
140	255°06	4°415	2°249	229°74	3°571	1°221		179°23	7°940	1°556	
145	255°57	5°702	2°306	235°01	4°488	1°503		183°20	9°387	2°383	
150	256°05	7°471	2°290	240°25	5°802	1°887		187°28	11°190	3°495	
155	256°51	9°958	2°127	245°45	7°746	2°424		191°51	13°42	4°98	
160	256°95	13°494	1°675	250°62	10°712	3°193		195°89	16°09	6°91	
165	257°38	18°451	0°675	255°74	15°29	4°30		200°47	19°10	9°33	
167°5	257°59	21°505	—0°149								
170	257°81	24°837	1°253								
175	258°24	31°15	4°31								
+180	258°68	33°63	—7°67	270°84	34°26	—7°49		215°57	24°57	—16°17	

GROUP 10.

The three chief comets in the tracks of known meteor-swarms.

1861, I. (<i>Lyrids</i>). Oppolzer.—Eq. 61°0.				1862, III. (<i>Perseids</i>). Oppolzer.—Eq. 62°0.			1866, I. (<i>Leonids</i>). Oppolzer.—Eq. 66°0.		
θ	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$	l	$r \cos b$	$r \sin b$
—180	36°62	92°79	+59°88	149°09	43°66	—20°18	240°06	19°652	—0°918
175							235°29	18°981	0°397
170	39°49	42°72	39°25	144°53	33°74	9°52	230°51	17°175	+0°086
165				142°51	25°723	5°096	225°74	14°827	0°459
160	43°41	14°41	19°03	140°36	19°292	2°243	220°95	12°453	0°706
155				138°35	14°593	0°523	216°16	10°336	0°849
150	49°51	5°84	10°84	136°35	11°227	+0°496	211°40	8°570	0°918
145				134°33	8°793	1°097	206°50	7°142	0°938
140	60°80	2°647	7°520	132°28	7°001	1°447	201°63	6°001	0°929
135	70°92	1°592	5°780	130°16	5°652	1°646	196°72	5°092	0°903
130	87°03	1°044	4°854	127°93	4°615	1°750	191°78	4°366	0°868
125	111°21	0°753	4°121	125°57	3°803	1°795	186°80	3°781	0°828
120	138°60	0°673	3°529	123°02	3°154	1°802	181°77	3°308	0°785
115	159°77	0°716	3°042	120°24	2°630	1°784	176°71	2°921	0°743
110	173°28	0°797	2°634	117°16	2°201	1°749	171°61	2°603	0°700
105	181°86	0°878	2°287	113°68	1°845	1°705	166°47	2°339	0°660
100	187°63	0°947	1°988	109°71	1°549	1°653	161°30	2°119	0°621
90	194°86	1°042	1°500	99°62	1°094	1°538	150°89	1°779	0°547
80	199°29	1°091	1°115	85°27	0°782	1°416	140°42	1°535	0°478
70	202°42	1°107	0°801	65°08	0°591	1°292	129°96	1°359	0°415
60	204°85	1°099	0°539	40°58	0°513	1°167	119°57	1°230	0°354
50	206°90	1°074	0°314	17°93	0°523	1°043	109°28	1°137	0°300
40	208°76	1°025	0°116	1°08	0°581	0°919	99°15	1°071	0°247
30	210°54	0°984	—0°058	349°31	0°656	0°794	89°18	1°024	0°195
20	212°36	0°924	0°217	340°84	0°734	0°668	79°36	0°995	0°145
10	214°34	0°854	0°363	334°34	0°807	0°538	69°66	0°979	0°095
0	216°62	0°774	0°499	329°09	0°874	0°404	60°06	0°975	0°046
+10	219°49	0°683	0°628	324°53	0°933	0°263	50°51	0°984	—0°005
20	223°41	0°568	0°750	320°36	0°985	0°115	40°95	1°004	0°057
30	229°51	0°468	0°868	316°35	1°029	—0°045	31°40	1°037	0°111
40	240°80	0°342	0°973	312°28	1°065	0°220	21°63	1°086	0°168
50	267°03	0°235	1°094	307°93	1°091	0°414	11°78	1°154	0°229
+60	318°60	0°329	—1°203	303°02	1°107	—0°632	1°77	1°246	—0°296

GROUP 10—*continued.*1861, I. (*Lyrids*).
Oppolzer.—Eq. 61°0.1862, III. (*Perseids*).
Oppolzer.—Eq. 62°0.1866, I. (*Leonids*).
Oppolzer.—Eq. 66°0.

<i>v</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>	<i>l</i>	<i>r</i> cos <i>b</i>	<i>r</i> sin <i>b</i>
+70	353°28	0°396	1°308	297°16	1°112	—0°884	351°61	1°372	—0°369
80	7°63	0°671	1°408	289°71	1°106	1°180	341°30	1°543	0°452
90	14°86	1°042	1°500	279°62	1°094	1°538	330°89	1°779	0°547
100	19°29	1°541	1°574	265°27	1°095	1°983	320°42	2°108	0°657
105	20°97	1°856	1°599	255°93	1°117	2°250	315°19	2°321	0°719
110	22°42	2°229	1°613	245°08	1°170	2°556	309°96	2°578	0°787
115	23°70	2°679	1°610	233°04	1°276	2°911	304°75	2°888	0°862
120	24°85	3°226	1°581	220°58	1°461	3°326	299°57	3°266	0°944
125	25°91	3°906	1°515				294°41	3°730	1°035
130	26°90	4°765	1°393	197°93	2°212	4°412	289°28	4°304	1°135
135	27°85	5°878	1°182				284°20	5°020	1°245
140	28°76	7°921	0°896	181°08	3°821	6°043	279°15	5°918	1°364
145	29°65	9°391	0°252				274°14	7°047	1°489
150	30°54	12°293	+0°727	169°31	7°160	8°662	269°18	8°466	1°614
155	31°44	16°626	2°427				264°25	10°226	1°726
160	32°36	23°439	5°507	160°84	14°37	13°07	259°36	12°341	1°800
165							254°50	14°725	1°797
170	34°34	53°39	22°71	154°34	29°17	19°45	249°66	17°094	1°665
175							244°86	18°501	1°369
+180	36°62	92°79	+59°88	149°09	43°66	—20°18	240°06	19°652	—0°918

The graphical construction of a few intersects of cometary orbits on properly prepared paper, on which the intersects of the major planets are also laid down, will show to reflecting readers how much information may be got from these intersects even by mere inspection, and how much more may be derived with comparatively little trouble. The chief peculiarities of the orbits in reference to the Sun and to the plane of the ecliptic are directly exhibited in the intersects, and, though in order to learn what the corresponding longitudes are the lists of co-ordinates have to be consulted, approximate information respecting also the longitudes may be got at sight, if the portions of the intersects within the different sextants or quadrants of ecliptical longitude are inked in with inks of different colours, or are distinguished in some other way. With the help of an ordinary semicircular protractor, which is held perpendicular to the paper, with its centre coinciding with the zero of the co-ordinates or with the place of the Sun, and so as to represent the plane of

the ecliptic, it will be easy to form correct notions of the relative positions of a comet and of the Earth, when their heliocentric positions are given or are assumed. For, as the heliocentric place, l, x, z , of the comet is represented by the point x, z of its intersect on condition that the plane of the intersect is supposed to be in the heliocentric longitude l , the position of the Earth L, R, o , will be referred to this plane by making the radius vector R form the angle $l-L$ with the plane of the paper. Thus the position of the comet as seen from different points of the Earth's orbit may be readily recognised in reference to its heliocentric position, and the consideration of the circumstances of the comet's geocentric apparition under various conditions will give comparatively little trouble, as readers who make actual trial will find out for themselves.

The explanations which are required refer to the determinations of the proximities of the orbits. The intersects of the major planets being comparatively of small extent, while those of cometary orbits are large, the vicinity of the point of the cometary orbit, where it approaches nearest to the planetary orbit, will be readily recognised by inspection of the intersects, some regard being paid that the ecliptical longitudes should approximately correspond. To find the points of the true proximity, recourse must be had to the lists of co-ordinates and to proper computation.

Let l_o, x_o, z_o denote the co-ordinates of a point of the cometary, l, x, z those of a point of the planetary orbit. The linear distance Δ between the two points is found by

$$\Delta^2 = 4xx_o \sin^2 \frac{1}{2}(l-l_o) + (x-x_o)^2 + (z-z_o)^2.$$

The differentiation of this equation furnishes the equation of condition for determining the longitude l of that point of the planetary orbit which is nearest to the point l_o, x_o, z_o ,

$$0 = xx_o \sin(l-l_o) + (x-x_o \cos(l-l_o)) \frac{dx}{dl} + (z-z_o) \frac{dz}{dl},$$

an equation which can only be solved by successive approximations, as the values of x, z , and of the differential coefficients

$$\frac{dx}{dl} \text{ and } \frac{dz}{dl}$$

must correspond to the value of l , which is to be determined. By putting

$$\frac{dz}{xdl} = \tan \mu,$$

the equation for the determination of l becomes

$$0 = \sin(l-\mu-l_o) + \frac{x}{x_o} \cdot \sin \mu + \frac{z-z_o}{x_o} \cdot \frac{dz}{xdl} \cdot \cos \mu,$$

the solution of which would be most readily effected, if the list of co-ordinates of the planetary orbit contained additional columns furnishing the values of

$$\mu, \sin \mu \text{ and of } \frac{dz}{xdl} \cos \mu = v,$$

determined by means of the equations

$$\tan \mu = \frac{dx}{xdl} = \frac{re \sin v}{p \cos i} - z \cdot \frac{\tan i}{p} (\cos u + e \cos \omega)$$

and

$$v = \frac{dz}{xdl} \cdot \cos \mu = x \cdot \frac{\tan i}{p} (\cos u + e \cos \omega) \cos \mu,$$

in which p denotes the semiparameter of the orbit and $u = \omega + v$ the argument of latitude or the departure from the node.

But in practice it may perhaps be considered sufficiently accurate to find the differential-coefficients from the differences of the published values of x and z , and to use the equation for the determination of l in the form

$$-\sin(l-l_0) = \frac{x-x_0}{x_0} \cdot \frac{dx}{xdl} + \frac{z-z_0}{x_0} \cdot \frac{dz}{xdl} + 2 \sin \frac{1}{2}(l-l_0) \cdot \frac{dx}{xdl}$$

in which the last term is to be disregarded in the first approximation.

With the determination of the true value of l the point of the planetary orbit is found which is nearest to the point l_0, x_0, z_0 of the cometary orbit, which was assumed to be near the point of proximity. By repeating the determination for suitably altered values of l_0 , and by comparing the resulting values Δ of the shortest distances, that value of l_0 is found which gives the minimum of the shortest distances and therewith the points of the closest proximity between the orbits.

This general method of solving the problem is only recommended in case one of the orbits is that of a major planet, and when the solution is wanted regardless of what the amount of the proximity may be. The determination of the proximities of the orbits of minor planets and of comets between themselves does not appear to have any practical interest, except in the cases of close proximities, when the orbits approach within, say, 0.01, or, at most, 0.02 of linear distance. Whether two orbits can approach within that limit is easily settled with the help of their intersects and the intersect data. Close proximities can only occur if the intersects cross or at least very nearly touch one another. In order that at the crossing points the two orbits should be within the assigned limits of distance 0.01 or 0.02, the ecliptical longitudes of the crossing points in the two orbits must not differ by more than $\frac{0^\circ.573}{x}$ or $\frac{1^\circ.146}{x}$, and,

where the intersects are merely close together, the difference between the longitudes must be still less. A reference to the intersect-data and a look at the longitudes of the points in question will decide at once whether there is the usual disagreement of the longitudes, or whether they agree near enough to require closer examination. In the latter case the computation of Δ for a few points in the neighbourhood will lead to the recognition of the true proximity. In the rare and exceptional cases of very close approaches it will, of course, be worth while to recompute the intersect-data for these points with greater accuracy, so as to insure that degree of correctness which may be considered desirable.

The application of this method for finding any close proximities between two orbits to the solution of the problem of finding all close proximities between any special orbit and all the other orbits is obvious. If the number of orbits which are to be considered is large, their intersects cannot be laid down on one sheet without overcrowding, but have to be judiciously spread over a series of sheets in collections of perhaps twenty or thirty intersects, so assorted as to permit clear discrimination. The search for close proximities between any special orbit and all the others may then be accomplished by means of a piece of tracing paper, on which the intersect of the special orbit is drawn, and which is to be placed in its correct position on each sheet.

The task of constructing the intersects graphically (on properly prepared paper, and with the intersect-data ready at hand) is a pleasant and instructive one, and the search for close proximities offers no difficulties and is interesting. The only drawback is, that it demands leisure, and that, if it is to be extended to many special orbits, the search cannot be indulged in but by those who can afford the time to undertake it. Except for this drawback, the solution of the problem of finding all close proximities between all fairly determined orbits of planets and comets would be within comparatively easy reach by applying the method generally. For though, when hundreds of orbits are to be considered, their mutual combinations may be counted by myriads, all those combinations, in which the intersects do not cross or touch, disappear at once from consideration as being obviously barren of proximities; the barrenness of a very large proportion of combinations will be easily recognised by a comparatively slight search; and only a moderate proportion of combinations will demand closer examination in order to discover the few hundred cases which will require strict investigation.

A special case of the problem of close proximities between two orbits is that in which one of the orbits is supplanted by a given straight line. The problem offers itself in astronomical practice in investigations concerning the possible identity of some periodical comet with one of the lost comets, which have

been observed only once or twice, and the orbit of which is unknown. The question whether at the time of the observation any point of the orbit of the periodical comet can have appeared in the observed place of the heavens will be most readily settled with the help of the two intersects, that of the orbit of the periodical comet and that of the straight line between the Earth and the lost comet. The following are the intersect-data for three of the lost comets:—the comet observed by Olbers, 1817, November 1 (*v. Berliner Astr. Jahrbuch*, 1817, p. 143); that observed by Hind, 1846, October 18 (*A. N.* 25, 206), and the object seen by Brorsen, 1854, March 16 (*A. N.* 38, 141). The argument Δ of the data is the geocentric distance of some point in the direction of the comet.

Δ	♂ 1817, Nov. 1.				♂ 1846, Oct. 18.				? ♂ 1854, March 16.			
	l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$		l	$r \cos b$	$r \sin b$	
0.0	39 ⁰ 01	0.992	0.000	25.44	0.995	0.000			175 ⁰ 90	0.996	0.000	
0.1	36.09	.923	+0.053	28.62	.914	+0.024			172.03	.923	-0.022	
0.2	32.70	.856	.105	32.40	.836	.047			167.52	.855	.045	
0.3	28.76	.793	.158	36.97	.762	.071			162.28	.793	.067	
0.4	24.15	.734	.211	42.45	.695	.095			156.20	.739	.089	
0.5	18.79	.681	.264	49.04	.635	.119			149.26	.694	.112	
0.6	12.58	.634	.316	56.88	.585	.142			141.50	.661	.134	
0.7	5.48	.596	.369	65.98	.547	.166			133.10	.641	.157	
0.8	357.57	.569	.422	76.11	.526	.190			124.36	.636	.179	
0.9	349.03	.553	.474	86.75	.521	.213			115.68	.646	.201	
1.0	340.20	0.550	+0.527	97.20	0.535	+0.237			107.43	0.669	-0.224	

If the intersects of these and the other lost comets are laid down on a piece of tracing paper and placed upon the intersect of the periodical comet, the comparison of the ecliptical longitudes of the intersects at the crossing points will show whether there is any case requiring closer examination. In making the comparison, due allowance must be made not only for precession but also for the possible shifting of the intersect of the periodical comet in the interval.

It will scarcely be necessary to point to the great usefulness of the intersects of the orbits of planets and comets in some other investigations. I hope to extend the lists of intersect-data so as to comprehend all well-determined orbits and postpone some further remarks till then.

*Colonel Cooper's Observatory :
Markree, Collooney, Ireland..*

Ephemeris for Physical Observations

Greenwich Noon.	Angle of Position of $\mathcal{L}$'s Axis.	Latitude of Earth Sun above $\mathcal{L}$'s Equator.			Annual Parallax.	Longitude of $\mathcal{L}$'s Central Meridian. (878°40) (870°31)		Corr. for Phase.
	P	B	B	A-L.	L-O.	I	II	
1885.								
Nov. 14	25°431	-1°992	-1°811	-8°305	44°459	154°20	355°48	+0°300
19	'415	2°035	1°828	8°744	45°278	225°71	26°54	'333
24	'396	2°077	1°844	9°140	46°054	297°29	57°66	'364
29	'374	2°119	1°860	9°490	46°782	8°92	88°84	'392
Dec. 4	25°350	-2°160	-1°876	-9°789	47°461	80°62	120°08	+0°417
9	'325	2°200	1°892	10°033	48°085	152°38	151°39	'438
14	'300	2°238	1°908	10°220	48°651	224°21	182°77	'455
19	'276	2°275	1°924	10°346	49°155	296°11	214°21	'466
24	'253	2°311	1°940	10°406	49°594	8°07	245°72	'471
29	'233	2°345	1°955	10°397	49°965	80°11	277°31	'470
1886.								
Jan. 3	25°216	-2°377	-1°971	-10°317	50°264	152°21	308°96	+0°463
8	'203	2°407	1°987	10°162	50°488	224°39	340°68	'449
13	'194	2°435	2°002	9°930	50°634	296°64	12°47	'429
18	'190	2°460	2°018	9°619	50°702	8°95	44°33	'403
23	'191	2°482	2°033	9°229	50°691	81°33	76°26	'371
28	'196	2°502	2°048	8°759	50°600	153°78	108°25	'334
Feb. 2	25°206	-2°518	-2°063	-8°211	50°430	226°28	140°30	+0°294
7	'220	2°531	2°078	7°585	50°182	298°84	172°41	'251
12	'238	2°541	2°093	6°885	49°862	11°44	204°56	'207
17	'259	2°547	2°108	6°117	49°471	84°09	236°75	'163
22	'281	2°548	2°123	5°285	49°018	156°77	268°98	'122
27	'305	2°546	2°137	4°396	48°508	229°47	301°23	'084
Mar. 4	25°331	-2°540	-2°152	-3°459	47°951	302°18	333°49	+0°052
9	'355	2°530	2°166	2°485	47°354	14°90	5°76	'027
14	'377	2°516	2°180	1°484	46°729	87°61	38°01	'010
19	'397	2°499	2°194	0°465	46°088	160°29	70°25	0°001
24	'415	2°479	2°208	+0°560	45°442	232°94	102°45	-0°001
29	'429	2°456	2°222	1°579	44°799	305°55	134°60	'011
Apr. 3	25°440	-2°431	-2°236	+2°581	44°177	18°09	166°70	-0°029
8	'448	2°404	2°250	3°554	43°581	90°58	198°74	'055
13	'453	2°376	2°264	4°489	43°023	162°99	230°70	'088
18	'456	2°347	2°278	5°377	42°514	235°31	262°58	'126
23	'457	2°318	2°291	6°210	42°059	307°56	294°37	'168
28	'456	2°289	2°304	6°983	41°654	19°71	326°07	'213
May 3	25°455	-2°261	-2°318	+7°689	41°335	91°76	357°68	-0°258

of Jupiter 1885-86. By A. Marth.

Greenwich Noon.	Diameter Equat. Po.ar.		Difference of limbs in A. R. in Decl.		Defect of illumination. Equat. in A. R. in Decl. preced. limb north l.			d	w
1885.									
Nov. 14	32"71	30"63	2'156	31'02	0"17	0'010	0'03	8°30	268°82
19	33'07	30'97	2'179	31'36	'19	'011	'03	8'74	268'71
24	33'46	31'33	2'205	31'73	'21	'012	'04	9'14	268'61
29	33'87	31'72	2'233	32'12	'23	'013	'04	9'49	268'51
Dec. 4	34'31	32'13	2'262	32'54	0'25	0'014	0'04	9'79	268'41
9	34'78	32'57	2'293	32'98	'27	'015	'05	10'03	268'32
14	35'27	33'03	2'325	33'45	'28	'016	'05	10'22	268'23
19	35'78	33'51	2'359	33'93	'29	'016	'05	10'35	268'13
24	36'31	34'01	2'394	34'44	'30	'017	'05	10'41	268'03
29	36'86	34'52	2'430	34'96	'30	'017	'05	10'40	267'92
1886.									
Jan. 3	37'43	35'05	2'468	35'49	0'30	0'017	0'05	10'32	267'81
8	38'00	35'59	2'506	36'04	'30	'017	'05	10'16	267'68
13	38'59	36'13	2'544	36'59	'29	'017	'05	9'93	267'54
18	39'17	36'68	2'583	37'14	'28	'016	'04	9'62	267'39
23	39'75	37'22	2'621	37'69	'26	'015	'04	9'23	267'22
28	40'32	37'76	2'658	38'23	'24	'013	'04	8'76	267'03
Feb. 2	40'88	38'28	2'695	38'76	0'21	0'012	0'03	8'22	266'79
7	41'41	38'78	2'730	39'27	'18	'010	'03	7'59	266'51
12	41'91	39'24	2'763	39'74	'15	'009	'02	6'90	266'18
17	42'37	39'67	2'793	40'18	'12	'007	'02	6'13	265'77
22	42'78	40'06	2'820	40'57	'09	'005	'01	5'30	265'21
27	43'14	40'39	2'843	40'91	'06	'004	'01	4'41	264'57
Mar. 4	43'43	40'67	2'863	41'19	0'04	0'002	0'00	3'48	263'24
9	43'65	40'89	2'878	41'41	'02	'001		2'51	261'9
14	43'82	41'04	2'888	41'56	'01	'000		1'53	256'4
19	43'90	41'11	2'894	41'64	on following		on south	0'57	235'0
24	43'91	41'12	2'895	41'65	limb		limb	0'63	117'3
29	43'84	41'05	2'890	41'58	'01	'000	'00	1'60	99'0
Apr. 3	43'70	40'92	2'881	41'45	0'02	0'001	0'01	2'59	94'5
8	43'48	40'72	2'867	41'24	'04	'002	'01	3'56	92'58
13	43'20	40'46	2'849	40'98	'07	'004	'01	4'49	91'43
18	42'86	40'14	2'827	40'65	'09	'005	'02	5'37	90'67
23	42'47	39'77	2'801	40'28	'12	'007	'02	6'20	90'14
28	42'03	39'36	2'772	39'86	'15	'009	'03	6'98	89'71
May 3	41'55	38'91	2'741	39'41	0'19	0'010	0'03	7'68	89'38

Greenwich Noon.		Angle of Position of M's Axis.	Latitude of Earth Sun above M's Equator.		Annual Parallax.	Longitude of M's Central Meridian. (870°40') (870°31')		Corr. for Phase.	
		P	B	B	A-L.	L-O.	I	II	
1886.									
May	8	25°453	-2°234	-2°331	+8°324	41°077	163°72	29°19	-0°302
	13	452	2°209	2°344	8 886	40°893	235°59	60°61	344
	18	451	2°186	2°357	9°372	40°784	307°36	91°94	382
	23	450	2°165	2°370	9°783	40°751	19°04	123°17	417
	28	450	2°146	2°383	10°119	40°793	90°63	154°31	446
June	2	25°451	-2°130	-2°395	+10°381	40°909	162°13	185°37	-0°469
	7	451	2°117	2°408	10°569	41°098	233°56	216°35	486
	12	452	2°106	2°420	10°686	41°359	304°91	247°25	497
	17	453	2°098	2°433	10°734	41°688	16 18	278°08	501
	22	453	2°093	2°445	10°717	42°082	87°39	308°85	500
	27	452	2°091	2°457	10°638	42°539	158°54	339°55	492
July	2	25°449	-2°091	-2°469	+10°499	43°056	229°64	10°20	-0°480
	7	444	2°094	2°481	10°303	43°629	300°68	40°80	462
	12	436	2°099	2°493	10°053	44°256	11°68	71°35	440
	17	423	2°107	2°505	9°754	44°932	82°64	101°86	414
	22	406	2°117	2°517	9°408	45°656	153°56	132°34	385
	27	384	2°129	2°528	9°018	46°423	224°46	162°79	354
Aug.	1	25°358	-2°144	-2°539	+8°588	47°231	295°33	193°21	-0°321

The angle $\Lambda-L$ is the difference of the Jovicentric longitudes of the Sun and the Earth, reckoned in the plane of *Jupiter's* equator, $L-O+180^{\circ}$ the Jovicentric longitude of the Earth reckoned from O, the point of *Jupiter's* vernal equinox or the point of the ascending node of the planet's orbit on its equator. Two values of the "Longitude of $\mathcal{U}$'s Central Meridian" are given for each date, the first, computed with the daily rate of rotation $878^{\circ}40'$, being intended for comparing the observations of the white spots in the neighbourhood of the planet's equator; the second, computed with the rate $870^{\circ}31'$, for the observations of the remnant of the great reddish spot. As the variations of the motions of the white spot cannot yet be allowed for, on account of their apparent irregularities, I have adopted the daily rate $870^{\circ}40'$ as being the mean rate of rotation of the most persistent of the white spots from the autumn of 1880 to the spring of 1885, and have assumed the Zero Meridian so that it remains in the neighbourhood of that spot during the interval. I shall be ready to give the longitudes in the system of the present ephemeris, which correspond to the times of the observed passages of the white spots over the middle of the disc, when all, or nearly all, the observations have come to my knowledge. If the remnant of the great reddish spot should continue to rotate at the daily rate $870^{\circ}31'$, at which it has moved for more than two years,

Greenwich Noon.	Diameter		Difference of limbs in A. R. in Decl.		Defect of illumination.			<i>d</i>	<i>w</i>
	Equat.	Polar.			Equat. in A. R. preced. limb	in Decl. north <i>l</i> .			
1886.			^s	^{''}	^{''}	^s			
May 8	41 ^{''} 04	38 ^{''} 43	2 ⁷ 08	38 ^{''} 93	0 ^{''} 22	0 ⁰ 012	0 ^{''} 04	8 [°] 32	89 [°] 11
13	40 ^{''} 50	37 ^{''} 93	2 ⁶ 73	38 ^{''} 42	24	0 ⁰ 14	04	8 [°] 88	88 [°] 88
18	39 ^{''} 95	37 ^{''} 41	2 ⁶ 36	37 ^{''} 89	27	0 ⁰ 15	05	9 [°] 37	88 [°] 68
23	39 ^{''} 39	36 ^{''} 88	2 ⁵ 99	37 ^{''} 36	29	0 ⁰ 16	05	9 [°] 78	88 [°] 51
28	38 ^{''} 82	36 ^{''} 35	2 ⁵ 62	36 ^{''} 82	30	0 ⁰ 17	05	10 [°] 11	88 [°] 36
June 2	38 ^{''} 25	35 ^{''} 82	2 ⁵ 24	36 ^{''} 28	31	0 ⁰ 18	0 ⁰ 05	10 [°] 38	88 [°] 22
7	37 ^{''} 69	35 ^{''} 29	2 ⁴ 87	35 ^{''} 75	32	0 ⁰ 18	0 ⁰ 05	10 [°] 57	88 [°] 09
12	37 ^{''} 14	34 ^{''} 77	2 ⁴ 50	35 ^{''} 22	32	0 ⁰ 18	0 ⁰ 05	10 [°] 68	87 [°] 98
17	36 ^{''} 59	34 ^{''} 27	2 ⁴ 14	34 ^{''} 71	32	0 ⁰ 18	0 ⁰ 05	10 [°] 73	87 [°] 87
22	36 ^{''} 07	33 ^{''} 77	2 ³ 79	34 ^{''} 21	31	0 ⁰ 18	0 ⁰ 05	10 [°] 71	87 [°] 77
27	35 ^{''} 56	33 ^{''} 30	2 ³ 45	33 ^{''} 73	30	0 ⁰ 17	0 ⁰ 05	10 [°] 63	87 [°] 67
July 2	35 ^{''} 07	32 ^{''} 84	2 ³ 12	33 ^{''} 26	29	0 ⁰ 17	0 ⁰ 05	10 [°] 50	87 [°] 58
7	34 ^{''} 60	32 ^{''} 40	2 ² 81	32 ^{''} 82	28	0 ⁰ 16	0 ⁰ 04	10 [°] 30	87 [°] 49
12	34 ^{''} 15	31 ^{''} 98	2 ² 52	32 ^{''} 39	26	0 ⁰ 15	0 ⁰ 04	10 [°] 05	87 [°] 39
17	33 ^{''} 73	31 ^{''} 58	2 ² 24	31 ^{''} 99	24	0 ⁰ 14	0 ⁰ 04	9 [°] 75	87 [°] 30
22	33 ^{''} 33	31 ^{''} 21	2 ¹ 97	31 ^{''} 61	22	0 ⁰ 13	0 ⁰ 04	9 [°] 41	87 [°] 20
27	32 ^{''} 95	30 ^{''} 86	2 ¹ 72	31 ^{''} 25	20	0 ⁰ 12	0 ⁰ 03	9 [°] 02	87 [°] 10
Aug. 1	32 ^{''} 60	30 ^{''} 53	2 ¹ 49	30 ^{''} 92	18	0 ⁰ 11	0 ⁰ 03	8 [°] 59	87 [°] 00

its place will be found near the Zero Meridian of column II. of the values of the Longitude of $\mathcal{J}$'s Central Meridian. The periods of rotation corresponding to the two adopted rates are

- I. 87^h8^m40^s period 9 50 9^s84
 II. 87^h0^m31^s 9 55 38^s99

The differences of successive values of the "Longitude, &c.," amount for the intervals of five days to 12 rotations in addition to the differences directly deduced, which must be borne in mind in interpolating. The differences of the values for Nov. 14 and Nov. 19 are, for instance, 4391[°]50 and 4351[°]06. The addition of the "Correction for phase" to the "Longitude of $\mathcal{J}$'s Central Meridian" gives the longitude of the Meridian which bisects the illuminated disc. A list of Greenwich times when this longitude is 0[°] will be found farther on.

The assumed value of *Jupiter's* equatorial diameter is 37^{''}60 at the distance 5[°]00273, or the apparent diameter $2a$ at the distance Δ

$$2a = \frac{195'' \cdot 62}{\Delta}.$$

The assumed proportion of the polar axis to the equatorial diameter or $\cos \epsilon_0$ is = 0.9363. The formulæ for finding the

apparent polar diameter of the disc, the difference of the tangents to the limbs in A. R. and Declin., and the defects of illumination are (v. vol. xl. p. 490 ff) :

$$\begin{aligned}\sin \epsilon &= \sin \epsilon_0 \cos B & \tan B_1 &= \sec \epsilon_0 \tan B \\ \sin \nu_1 &= \sin \epsilon \sin P & \tan B' &= \sec \epsilon_1 \tan B \sec (\Lambda - L) \\ \sin \nu' &= \sin \epsilon \cos P & \tan d \sin w &= \tan (\Lambda - L) \cos B' \sec (B_1 - B') \\ \tan P_1 &= \cos \epsilon \tan P & \tan d \cos w &= \tan (B_1 - B') \\ \tan P' &= \sec \epsilon \tan P\end{aligned}$$

$$\begin{aligned}\sin \delta &= \sin d \sin w & \sin \delta'' &= \sin d \cos w \\ \sin \delta_1 &= \sin d \sin (w + P_1) & \sin \delta' &= \sin d \cos (w + P')\end{aligned}$$

$$\begin{aligned}\text{App. equat. diameter} &= 2a & \text{Defect of illum.} &= 2a \cdot \sin^2 \frac{1}{2} \delta \\ \text{App. polar diameter} &= 2a \cos \epsilon & &= 2a \cos \epsilon \cdot \sin^2 \frac{1}{2} \delta'' \text{ (insensible)} \\ \text{Diff. of limbs in A.R.} &= \frac{2a \cos \nu_1}{15 \cos D} & &= \frac{2a \cos \nu_1}{15 \cos D} \cdot \sin^2 \frac{1}{2} \delta_1 \\ \text{,, in Decl.} &= 2a \cos \nu' & &= 2a \cos \nu' \cdot \sin^2 \frac{1}{2} \delta'\end{aligned}$$

The values of δ , &c., are, of course, not wanted, and, with the help of a little table giving

$$\log \frac{1}{4 \cos^2 \frac{1}{2} \delta}$$

belonging to the argument $\log \sin^2 \delta$, the values of $\sin^2 \frac{1}{2} \delta$ are found by the formula

$$\frac{\sin^2 \delta}{4 \cos^2 \frac{1}{2} \delta}.$$

The inclinations γ and the ascending nodes Γ of the orbits of the four satellites of *Jupiter* in reference to the plane of the planet's equator are the following, the longitudes of the nodes being reckoned from O, the point of the ascending node of *Jupiter's* orbit on its equator :—

1885.	γ_1	Γ_1	γ_2	Γ_2	γ_3	Γ_3	γ_4	Γ_4
Sept. 15	0°0116	305°2	0°4895	307°29	0°1545	252°54	0°3187	329°91
Nov. 14	0°116	303°7	4900	305°39	1°536	252°31	3°191	329°93
1886.								
Jan. 13	0°0117	302°3	0°4905	303°49	0°1527	252°09	0°3195	329°97
Mar. 14	0°118	300°9	4910	301°60	1°518	251°87	3°198	330°03
May 13	0°118	299°5	4914	299°21	1°508	251°64	3°201	330°10
July 12	0°118	298°2	4918	297°83	1°498	251°41	3°203	330°19
Sept. 10	0°0118	296°9	0°4921	295°94	0°1487	251°17	0°3205	330°29

The values for the preceding two years are given in the "Note on the Determination of the Planes of the Orbits of *Jupiter's* Satellites," published in vol. xlv. p. 241 ff. At the

end of that note it is pointed out that observers ought to be on the alert in 1886 to get complete observations of some of the last eclipses of the present cycle of eclipses of the fourth satellite. If, as is very probable, the tabular value of the node of that satellite's orbit on the orbit of *Jupiter* requires a very sensible positive correction, the durations of the last eclipses as given by the Tables will not only be found considerably too short, but there will be at least one additional eclipse on May 17 not given by the Tables, and there may be a second unpredicted one of short duration on June 3. It is not unlikely that the errors of the predicted times of the eclipse on March 11 may already amount to a quarter of an hour, the satellite disappearing so much earlier and reappearing so much later than the times set down in the *Nautical Almanac*, and these errors will then be considerably increased in the following eclipses, so that observers will have to look out early enough for the disappearance and watch long enough for the reappearance of the satellite. It is to be hoped that the opportunities for securing valuable observations will not be allowed to slip away unused by observers in Europe on March 11 and May 17 (middle of eclipse of uncertain duration at 11^h 26^m.8 G.M.T.), in Asia on March 28 and June 3 (middle of possible eclipse at 5^h 25^m.1 G.M.T.), in Australia on April 13 and in America on April 30. It is obvious that the times of corresponding phases at disappearance and reappearance must be observed, if good results are to be deduced.

The following is a list of Greenwich Mean Times, when the Zero Meridian in the assumed two systems of longitudes will pass the middle of the illuminated disc. To save printing, the time of only one passage is given for each day, and the others must be found by interpolation, or, if greater accuracy is not required, by adding or subtracting 9^h 50^m in the first system and 9^h 56^m in the second.

		I.		II.				I.		II.	
		(878° 40)		(870° 31)				(878° 40)		(870° 31)	
1885		h	m	h	m	1885		h	m	h	m
Nov.	9	17	24.4	20	49.8	Nov.	20	19	0.5	14	58.4
	10	22	55.1	16	41.2		21	14	40.9	20	45.5
	11	18	35.5	22	28.8		22	20	11.6	16	36.0
	12	14	16.0	18	19.4		23	15	52.0	22	24.9
	13	19	46.7	14	11.3		24	21	22.6	18	15.4
	14	15	27.1	19	58.4		25	17	3.1	14	6.8
	15	20	57.8	15	49.8		26	12	43.5	19	53.9
	16	16	38.3	21	37.0		27	18	14.1	15	45.3
	17	22	8.9	17	28.4		28	13	54.5	21	32.3
	18	17	49.4	13	19.8		29	19	25.1	17	23.7
	19	13	29.8	19	6.9		30	15	5.5	13	15.1

		I.	II.			I.	II.
		!(878°40)	(870°31)			(878°40)	(870°31)
1885		h m	h m	1886.		h m	h m
Dec.	1	20 36.1	19 2.2	Jan.	6	12 21.0	18 44.3
	2	16 16.5	14 53.5		7	17 51.4	14 35.6
	3	21 47.1	20 40.6		8	13 31.7	10 26.8
	4	17 27.5	16 32.0		9	19 2.1	16 13.7
	5	13 7.9	12 23.3		10	14 42.4	12 4.9
	6	18 38.5	18 10.4		11	10 22.6	17 51.8
	7	14 18.9	14 1.7		12	15 53.0	13 43.0
	8	19 49.5	19 48.8		13	11 33.3	19 29.9
	9	15 29.9	15 40.1		14	17 3.7	15 21.1
	10	21 0.4	21 27.1		15	12 43.9	11 12.3
	11	16 40.8	17 18.5		16	18 14.3	16 59.2
	12	12 21.1	13 9.8		17	13 54.5	12 50.4
	13	17 51.7	18 56.8		18	19 24.9	18 37.2
	14	13 32.0	14 48.2		19	15 5.1	14 28.4
	15	19 2.6	20 35.2		20	10 45.4	10 19.6
	16	14 42.9	16 26.5		21	16 15.7	16 6.4
	17	20 13.5	12 17.8		22	11 56.0	11 57.6
	18	15 53.8	18 4.8		23	17 26.3	17 44.4
	19	11 34.1	13 56.1		24	13 6.5	13 35.6
	20	17 4.7	19 43.1		25	8 46.7	9 26.8
	21	12 45.0	15 34.4		26	14 17.1	15 13.6
	22	18 15.5	11 25.7		27	9 57.3	11 4.8
	23	13 55.8	17 12.6		28	15 27.6	16 51.5
	24	19 26.3	13 3.9		29	11 7.8	12 42.7
	25	15 6.6	18 50.9		30	16 38.1	18 29.5
	26	20 37.1	14 42.2		31	12 18.3	14 20.6
	27	16 17.4	20 29.1	Feb.	1	17 48.6	10 11.8
	28	11 57.8	16 20.4		2	13 28.8	15 58.6
	29	17 28.2	12 11.7		3	9 9.0	11 49.7
	30	13 8.5	17 58.6		4	14 39.3	17 36.5
	31	18 39.0	13 49.9		5	10 19.5	13 27.6
1886.					6	15 49.7	9 18.8
Jan.	1	14 19.3	19 36.8		7	11 29.9	15 5.5
	2	19 49.7	15 28.0		8	17 0.2	10 56.7
	3	15 30.0	11 19.3		9	12 40.4	16 43.4
	4	11 10.3	17 6.2		10	8 20.6	12 34.5
	5	16 40.7	12 57.5		11	13 50.8	8 25.7

		I.		II.				I.		II.	
		(878°40)		(870°31)				(878°40)		(870°31)	
1886		h	m	h	m	1886		h	m	h	m
Feb.	12	9	31.0	14	12.4	Mar.	21	6	37.7	9	37.1
	13	15	1.2	10	3.5		22	12	7.9	15	23.8
	14	10	41.4	15	50.2		23	7	48.1	11	15.0
	15	16	11.7	11	41.4		24	13	18.3	7	6.1
	16	11	51.8	17	28.1		25	8	58.5	12	52.8
	17	17	22.1	13	19.2		26	14	28.8	8	43.9
	18	13	2.2	9	10.3		27	10	8.9	14	30.6
	19	8	42.4	14	57.0		28	15	39.2	10	21.8
	20	14	12.6	10	48.1		29	11	19.4	6	12.9
	21	9	52.8	16	34.8		30	6	59.5	11	59.6
	22	15	23.0	12	25.9		31	12	29.8	7	50.8
	23	11	3.1	8	17.1	Apr.	1	8	10.0	13	37.5
	24	16	33.4	14	3.7		2	13	40.3	9	28.7
	25	12	13.5	9	54.8		3	9	20.5	15	15.4
	26	17	43.7	15	41.5		4	14	50.8	11	6.6
	27	13	23.9	11	32.6		5	10	31.0	6	57.8
	28	9	4.0	7	23.8		6	6	11.2	12	44.5
Mar.	1	14	34.2	13	10.4		7	11	41.5	8	35.7
	2	10	14.4	9	1.5		8	7	21.7	14	22.5
	3	15	44.6	14	48.2		9	12	52.0	10	13.7
	4	11	24.7	10	39.3		10	8	32.3	6	4.9
	5	16	55.0	16	26.0		11	14	2.6	11	51.7
	6	12	35.1	12	17.1		12	9	42.9	7	42.9
	7	8	15.2	8	8.2		13	15	13.2	13	30.7
	8	13	45.5	13	54.9		14	10	53.4	9	20.9
	9	9	25.6	9	46.0		15	6	33.7	15	7.7
	10	14	55.8	15	32.6		16	12	4.1	10	58.9
	11	10	36.0	11	23.8		17	7	44.3	6	50.2
	12	6	16.1	7	14.9		18	13	14.7	12	37.0
	13	11	46.3	13	1.5		19	8	55.0	8	28.2
	14	7	26.5	8	52.6		20	14	25.4	14	15.1
	15	12	56.7	14	39.3		21	10	5.7	10	6.4
	16	8	36.8	10	30.4		22	15	36.1	15	53.2
	17	14	7.0	16	17.1		23	11	16.4	11	44.5
	18	9	47.2	12	8.2		24	6	56.8	7	35.8
	19	15	17.4	7	59.3		25	12	27.1	13	22.7
	20	10	57.6	13	46.0		26	8	7.4	9	13.1

		I.	II.			I.	II.
		(878°40')	(870°31')			(878°40')	(870°31')
		h m	h m			h m	h m
1886							
Apr.	27	13 37·9	15 0·8	May	29	12 53·1	11 28·2
	28	9 18·2	10 52·1		30	8 33·5	7 19·7
	29	14 48·7	16 39·1		31	14 4·2	13 6·8
	30	10 29·0	12 30·4	June	1	9 44·7	8 58·3
	—	17 28·4	Middle		2	15 15·4	14 45·5
	of last tabular eclipse of				3	5 25·1	? Middle
	Sat. IV.				of eclipse of Sat. IV.		
May	1	15 59·5	8 21·6	—		10 55·9	10 36·9
	2	11 39·8	14 8·6		4	6 36·4	6 28·4
	3	7 20·2	9 59·9		5	12 7·1	12 15·6
	4	12 50·7	15 46·9		6	7 47·6	8 7·0
	5	8 31·0	11 38·2		7	13 18·4	13 54·3
	6	14 1·5	7 29·5		8	8 58·9	9 45·7
	7	9 41·9	13 16·5		9	14 29·6	15 32·9
	8	15 12·4	9 7·9		10	10 10·1	11 24·4
	9	10 52·8	14 54·9		11	15 40·9	7 15·9
	10	16 23·4	10 46·2		12	11 21·4	13 3·1
	11	12 3·8	16 33·2		13	7 1·9	8 54·6
	12	7 44·1	12 24·6		14	12 32·7	14 41·9
	13	13 14·7	8 16·0		15	8 13·2	10 33·4
	14	8 55·1	14 3·0		16	13 44·0	6 24·9
	15	14 25·7	9 54·4		17	9 24·6	12 12·1
	16	10 6·1	15 41·4		18	14 55·4	8 3·7
	17	11 26·8	? Middle		19	10 35·9	13 50·9
	of eclipse of Sat. IV.				20	6 16·4	9 42·4
—		15 36·7	11 32·8		21	11 47·2	5 34·0
	18	11 17·1	7 24·2		22	7 27·8	11 21·2
	19	6 57·5	13 11·3		23	12 58·6	7 12·8
	20	12 28·2	9 2·7		24	8 39·2	13 0·1
	21	8 8·6	14 49·8		25	14 10·0	8 51·6
	22	13 39·2	10 41·2		26	9 50·6	14 38·9
	23	9 19·7	16 28·3		27	5 31·1	10 30·4
	24	14 50·3	12 19·7		28	11 2·0	6 22·0
	25	10 30·8	8 11·1		29	6 42·5	12 9·3
	26	16 1·5	13 58·2		30	12 13·4	8 0·8
	27	11 42·9	9 49·7	July	1	7 54·0	13 48·1
	28	7 22·4	15 36·8		2	13 24·8	9 39·7

		I.		II.				I.		II.	
		(878°40)		(870°31)				(878°40)		(870°31)	
1885		h	m	h	m	1886		h	m	h	m
July	3	9	5.4	15	27.0	July	20	14	17.9	14	34.2
	4	14	36.3	11	18.6		21	9	58.5	10	25.8
	5	10	16.9	7	10.1		22	5	39.1	6	17.4
	6	5	57.4	12	57.5		23	11	10.0	12	4.8
	7	11	28.3	8	49.0		24	6	50.7	7	56.4
	8	7	8.9	14	36.4		25	12	21.6	13	43.8
	9	12	39.8	10	27.9		26	8	2.2	9	35.4
	10	8	20.4	6	19.5		27	13	33.1	5	27.0
	11	13	51.3	12	6.9		28	9	13.8	11	14.4
	12	9	31.9	7	58.4		29	14	44.7	7	6.0
	13	5	12.5	13	45.8		30	10	25.3	12	53.4
	14	10	43.4	9	37.4		31	6	5.9	8	45.0
	15	6	24.0	5	28.9	Aug.	1	11	36.9	14	32.4
	16	11	54.9	11	16.3		2	7	17.5	10	24.0
	17	7	35.5	7	7.9		3	12	48.5	6	15.6
	18	13	6.4	12	55.3		4	8	29.1	12	3.0
	19	8	47.0	8	46.9						

Ephemerides of the Satellites of Saturn, 1885-86. By A. Marth.

(Continued from page 462.)

Differences of Right Ascension and Declination between the three outer Satellites and the Centre of Saturn.

		Titan.		Hyperion.		Iapetus.	
o ^h Gr.		$\alpha_s - A_s$	$\delta_s - D$	$\alpha_s - A_s$	$\delta_s - D$	$\alpha_s - A_s$	$\delta_s - D$
1885.		s	s	s	s	s	s
Dec.	1	- 4.79	- 92.3	+ 6.65	+ 102.8	+ 24.83	- 49.4
	2	+ 0.83	- 89.8	+ 1.05	+ 100.1	+ 27.61	- 37.0
	3	+ 6.34	- 74.5	- 4.67	+ 86.3	30.22	- 24.3
	4	+ 10.95	- 48.5	- 9.83	+ 62.1	+ 32.65	- 11.4
	5	+ 13.96	- 15.3	- 13.76	+ 30.2	34.88	+ 1.6
	6	+ 14.87	+ 20.2	- 15.96	- 5.7	+ 36.91	+ 14.6
	7	+ 13.47	+ 52.6	- 16.22	- 41.1	38.72	27.6
	8	+ 9.90	+ 76.6	- 14.63	- 71.9	+ 40.30	+ 40.6
	9	+ 4.70	+ 88.0	- 11.51	- 95.5	41.65	53.4
	10	- 1.30	+ 84.7	- 7.36	- 110.3	+ 42.74	+ 65.8
	11	- 7.09	+ 67.1	- 2.56	- 115.9	43.57	77.9
	12	- 11.71	+ 38.3	+ 2.45	- 112.8	+ 44.14	+ 89.7

R R

		<i>Titan.</i>		<i>Hyperion.</i>		<i>Iapetus.</i>	
Ob Gr.		$\alpha_s - A$	$\delta_s - D$	$\alpha_s - A$	$\alpha_s - D$	$\alpha_s - A$	$\delta_s - D$
1885.		s	"	s	"	s	"
Dec.	13	-14'44	+ 3'2	+ 7'30	- 101'7	+ 44'45	+ 100'9
	14	-14'89	- 32'5	+ 11'67	- 83'9	+ 44'50	+ 111'6
	15	-13'07	- 63'3	+ 15'30	- 60'7	44'27	121'6
	16	- 9'31	- 84'9	+ 17'98	- 33'7	+ 43'77	+ 131'0
	17	- 4'20	- 94'3	+ 19'52	- 4'5	43'01	139'6
	18	+ 1'51	- 90'2	+ 19'80	+ 25'1	+ 41'99	+ 147'3
	19	+ 7'01	- 73'4	+ 18'72	+ 52'9	40'71	154'2
	20	+ 11'50	- 46'0	+ 16'28	+ 76'9	+ 39'18	+ 160'2
	21	+ 14'31	- 11'8	+ 12'54	+ 94'8	37'41	165'2
	22	+ 14'96	+ 24'2	+ 7'69	+ 104'3	+ 35'41	+ 169'2
	23	+ 13'27	+ 56'3	+ 2'10	+ 103'6	33'19	172'2
	24	+ 9'45	+ 79'5	- 3'71	+ 91'6	+ 30'75	+ 174'2
	25	+ 4'07	+ 89'5	- 9'07	+ 68'9	28'12	175'0
	26	- 2'00	+ 84'5	- 13'30	+ 37'5	+ 25'32	+ 174'7
	27	- 7'73	+ 65'3	- 15'84	+ 1'3	22'36	173'3
	28	- 12'18	+ 35'2	- 16'42	- 35'1	+ 19'26	+ 170'8
	29	- 14'65	- 0'6	- 15'11	- 67'5	16'03	167'2
	30	- 14'82	- 36'4	- 12'21	- 92'9	+ 12'70	+ 162'5
	31	- 12'73	- 66'7	- 8'14	- 109'6	9'29	156'7
1886.							
Jan.	1	- 8'77	- 87'2	- 3'38	- 117'0	+ 5'82	+ 149'9
	2	- 3'53	- 95'2	+ 1'66	- 115'3	+ 2'31	142'1
	3	+ 2'20	- 89'6	+ 6'57	- 105'4	- 1'21	+ 133'3
	4	+ 7'62	- 71'3	+ 11'05	- 88'5	4'72	123'6
	5	+ 11'94	- 42'8	+ 14'81	- 65'9	- 8'20	+ 113'1
	6	+ 14'50	- 8'0	+ 17'65	- 39'1	11'61	101'8
	7	+ 14'86	+ 27'9	+ 19'37	- 9'9	- 14'94	+ 89'7
	8	+ 12'91	+ 59'5	+ 19'84	+ 19'9	18'16	77'0
	9	+ 8'88	+ 81'4	+ 18'99	+ 48'4	- 21'26	+ 63'8
	10	+ 3'39	+ 89'9	+ 16'75	+ 73'3	24'21	50'1
	11	- 2'66	+ 83'3	+ 13'22	+ 92'5	- 26'98	+ 36'1
	12	- 8'26	+ 62'7	+ 8'56	+ 103'7	29'56	21'8
	13	- 12'49	+ 31'7	+ 3'10	+ 104'9	- 31'92	+ 7'3
	14	- 14'69	- 4'4	- 2'68	+ 95'0	34'06	- 7'3
	15	- 14'58	- 39'8	- 8'12	+ 74'2	- 35'95	- 21'8
	16	- 12'26	- 69'2	- 12'55	+ 44'1	37'59	36'2
	17	- 8'14	- 88'5	- 15'38	+ 8'6	- 38'96	- 50'3
	18	- 2'85	- 94'9	- 16'29	- 28'1	40'05	64'1
	19	+ 2'83	- 88'0	- 15'30	- 61'5	- 40'85	- 77'4

		<i>Titan.</i>		<i>Hyperion.</i>		<i>Iapetus.</i>	
o ^b Gr.		$\alpha_s - A$	$\delta_s - D$	$\alpha_s - A$	$\delta_s - D$	$\alpha_s - A$	$\delta_s - D$
1886.		$\begin{smallmatrix} s \\ S \end{smallmatrix}$	$\begin{smallmatrix} '' \\ '' \end{smallmatrix}$	$\begin{smallmatrix} s \\ S \end{smallmatrix}$	$\begin{smallmatrix} '' \\ '' \end{smallmatrix}$	$\begin{smallmatrix} s \\ S \end{smallmatrix}$	$\begin{smallmatrix} '' \\ '' \end{smallmatrix}$
Jan.	20	+ 8 ^h 10	- 68 ^m 5	- 12 ^h 66	- 88 ^m 3	- 41 ^h 36	- 90 ^m 2
	21	+ 12 ^h 20	- 39 ^m 3	- 8 ^h 80	- 106 ^m 5	- 41 ^h 57	- 102 ^m 4
	22	+ 14 ^h 50	- 4 ^m 3	- 4 ^h 18	- 115 ^m 6	41 ^h 49	113 ^m 8
	23	+ 14 ^h 60	+ 31 ^m 2	+ 0 ^h 77	- 115 ^m 5	- 41 ^h 12	- 124 ^m 4
	24	+ 12 ^h 42	+ 61 ^m 7	+ 5 ^h 66	- 107 ^m 2	40 ^h 46	134 ^m 2
	25	+ 8 ^h 25	+ 82 ^m 3	+ 10 ^h 16	- 91 ^m 6	- 39 ^h 52	- 143 ^m 0
	26	+ 2 ^h 73	+ 89 ^m 2	+ 14 ^h 00	- 70 ^m 1	38 ^h 30	150 ^m 8
	27	- 3 ^h 24	+ 81 ^m 2	+ 16 ^h 95	- 44 ^m 2	- 36 ^h 81	- 157 ^m 5
	28	- 8 ^h 65	+ 59 ^m 6	+ 18 ^h 83	- 15 ^m 7	35 ^h 07	163 ^m 2
	29	- 12 ^h 60	+ 28 ^m 2	+ 19 ^h 51	+ 13 ^m 8	- 33 ^h 10	- 167 ^m 7
	30	- 14 ^h 55	- 7 ^m 8	+ 18 ^h 89	+ 42 ^m 3	30 ^h 91	171 ^m 0
	31	- 14 ^h 20	- 42 ^m 4	+ 16 ^h 95	+ 67 ^m 7	- 28 ^h 51	- 173 ^m 2
Feb.	1	- 11 ^h 71	- 70 ^m 7	+ 13 ^h 72	+ 87 ^m 9	25 ^h 92	174 ^m 2
	2	- 7 ^h 51	- 88 ^m 5	+ 9 ^h 34	+ 100 ^m 7	- 23 ^h 16	- 174 ^m 0
	3	- 2 ^h 23	- 93 ^m 6	+ 4 ^h 12	+ 104 ^m 0	20 ^h 26	172 ^m 7
	4	+ 3 ^h 34	- 85 ^m 5	- 1 ^h 51	+ 96 ^m 5	- 17 ^h 24	- 170 ^m 2
	5	+ 8 ^h 43	- 65 ^m 3	- 6 ^h 93	+ 78 ^m 1	14 ^h 11	166 ^m 6
	6	+ 12 ^h 29	- 35 ^m 8	- 11 ^h 50	+ 50 ^m 3	- 10 ^h 89	- 161 ^m 9
	7	+ 14 ^h 33	- 1 ^m 1	- 14 ^h 60	+ 16 ^m 2	7 ^h 62	156 ^m 1
	8	+ 14 ^h 21	+ 33 ^m 6	- 15 ^h 86	- 19 ^m 9	- 4 ^h 31	- 149 ^m 4
	9	+ 11 ^h 88	+ 62 ^m 9	- 15 ^h 21	- 53 ^m 6	- 0 ^h 98	141 ^m 7
	10	+ 7 ^h 64	+ 82 ^m 1	- 12 ^h 98	- 81 ^m 4	+ 2 ^h 35	- 133 ^m 2
	11	+ 2 ^h 16	+ 87 ^m 6	- 9 ^h 43	- 101 ^m 2	5 ^h 65	123 ^m 8
	12	- 3 ^h 67	+ 78 ^m 5	- 5 ^h 05	- 112 ^m 0	+ 8 ^h 90	- 113 ^m 6
	13	- 8 ^h 86	+ 56 ^m 3	- 0 ^h 27	- 113 ^m 8	12 ^h 08	102 ^m 8
	14	- 12 ^h 58	+ 24 ^m 9	+ 4 ^h 51	- 107 ^m 3	+ 15 ^h 18	- 91 ^m 4
	15	- 14 ^h 27	- 10 ^m 4	+ 8 ^h 97	- 93 ^m 5	18 ^h 18	79 ^m 4
	16	- 13 ^h 74	- 44 ^m 1	+ 12 ^h 84	- 73 ^m 8	+ 21 ^h 05	- 67 ^m 0
	17	- 11 ^h 15	- 71 ^m 0	+ 15 ^h 90	- 49 ^m 4	23 ^h 78	54 ^m 2
	18	- 6 ^h 93	- 87 ^m 6	+ 17 ^h 96	- 22 ^m 1	+ 26 ^h 36	- 41 ^m 1
	19	- 1 ^h 73	- 91 ^m 6	+ 18 ^h 88	+ 6 ^m 5	28 ^h 78	27 ^m 8
	20	+ 3 ^h 69	- 82 ^m 6	+ 18 ^h 56	+ 34 ^m 6	+ 31 ^h 02	- 14 ^m 4
	21	+ 8 ^h 57	- 62 ^m 0	+ 16 ^h 96	+ 60 ^m 2	33 ^h 06	- 1 ^m 0
	22	+ 12 ^h 21	- 32 ^m 7	+ 14 ^h 11	+ 81 ^m 2	+ 34 ^h 90	+ 12 ^m 5
	23	+ 14 ^h 05	+ 1 ^m 4	+ 10 ^h 11	+ 95 ^m 5	36 ^h 53	25 ^m 9
	24	+ 13 ^h 76	+ 35 ^m 0	+ 5 ^h 22	+ 101 ^m 1	+ 37 ^h 95	+ 39 ^m 0
	25	+ 11 ^h 32	+ 63 ^m 1	- 0 ^h 17	+ 96 ^m 4	39 ^h 14	51 ^m 8
	26	+ 7 ^h 10	+ 80 ^m 9	- 5 ^h 51	+ 81 ^m 0	+ 40 ^h 09	+ 64 ^m 3

		<i>Titan.</i>		<i>Hyperion.</i>		<i>Iapetus.</i>	
o ^h Gr. 1886		α_s -A	δ_s -D	α_s -A	δ_s -D	α_s -A	δ_s -D
Feb.	27	+ 1'71	+ 85''4	- 10'17	+ 56''1	+ 40'81	+ 76''4
	28	- 3'94	+ 75'6	- 13'54	+ 24'1	+ 41'29	+ 88'0
Mar.	1	- 8'92	+ 53'2	- 15'20	- 10'7	41'53	99'1
	2	- 12'42	+ 22'2	- 15'05	- 44'2	+ 41'52	+ 109'5
	3	- 13'92	- 12'3	- 13'22	- 72'7	41'28	119'3
	4	- 13'27	- 44'8	- 10'08	- 93'9	+ 40'80	+ 128'3
	5	- 10'63	- 70'5	- 6'03	- 106'5	40'09	136'5
	6	- 6'45	- 85'9	- 1'51	- 110'5	+ 39'16	+ 144'0
	7	- 1'37	- 89'0	+ 3'11	- 106'3	38'08	150'6
	8	+ 3'88	- 79'6	+ 7'51	- 95'0	+ 36'62	+ 156'3
	9	+ 8'56	- 59'0	+ 11'40	- 77'3	35'03	161'0
	10	+ 12'01	- 30'1	+ 14'57	- 54'9	+ 33'25	+ 164'8
	11	+ 13'69	+ 3'1	+ 16'82	- 29'2	31'28	167'6
	12	+ 13'30	+ 35'6	+ 18'02	- 1'8	+ 29'14	+ 169'4
	13	+ 10'85	+ 62'5	+ 18'06	+ 25'6	26'84	170'2
	14	+ 6'66	+ 79'2	+ 16'87	+ 51'1	+ 24'38	+ 170'0
	15	+ 1'40	+ 82'9	+ 14'46	+ 72'8	21'79	168'7
	16	- 4'07	+ 72'7	+ 10'91	+ 88'6	+ 19'07	+ 166'5
	17	- 8'85	+ 50'5	+ 6'41	+ 96'5	16'26	163'2
	18	- 12'17	+ 20'2	+ 1'32	+ 94'9	+ 13'36	+ 159'0
	19	- 13'54	- 13'3	- 3'90	+ 83'0	10'39	153'9
	20	- 12'82	- 44'7	- 8'63	+ 61'4	+ 7'36	+ 147'8
	21	- 10'19	- 69'2	- 12'27	+ 32'3	4'31	140'8
	22	- 6'10	- 83'7	- 14'36	- 0'8	+ 1'24	+ 133'0
	23	- 1'16	- 86'3	- 14'72	- 33'6	- 1'84	124'4
	24	+ 3'93	- 76'7	- 13'43	- 62'7	- 4'88	+ 115'1
	25	+ 8'45	- 56'4	- 10'76	- 85'2	7'87	105'1
	26	+ 11'74	- 28'2	- 7'12	- 99'9	- 10'81	+ 94'4
	27	+ 13'31	+ 4'0	- 2'91	- 106'5	13'67	83'2
	28	+ 12'87	+ 35'5	+ 1'52	- 104'6	- 16'43	+ 71'6
	29	+ 10'44	+ 61'3	+ 5'83	- 95'8	19'07	59'6
	30	+ 6'34	+ 77'2	+ 9'75	- 80'8	- 21'57	+ 47'2
	31	+ 1'22	+ 80'3	+ 13'03	- 60'6	23'93	34'5
April	1	- 4'08	+ 70'1	+ 15'50	- 36'9	- 26'12	+ 21'7
	2	- 8'69	+ 48'3	+ 17'01	- 11'0	28'14	+ 8'8
	3	- 11'87	+ 18'7	+ 17'44	+ 15'5	- 29'96	- 4'0
	4	- 13'15	- 13'7	+ 16'70	+ 40'8	31'57	16'7
	5	- 12'43	- 44'0	+ 14'77	+ 63'3	- 32'97	- 29'3

o ^h Gr. 1886.	<i>Titan.</i>		<i>Hyperion.</i>		<i>Iapetus.</i>	
	$\alpha_s - A$ s	$\delta_s - D$ "	$\alpha_s - A$ s	$\delta_s - D$ "	$\alpha_s - A$ s	$\delta_s - D$ "
Apr. 6	- 9.85	- 67.6	+ 11.72	+ 80.5	- 34.15	- 41.6
7	- 5.87	- 81.4	+ 7.66	+ 90.8	- 35.10	- 53.6
8	- 1.07	- 83.6	+ 2.98	+ 92.4	35.81	65.1
9	+ 3.87	- 74.2	- 2.07	+ 84.2	- 36.28	- 76.2
10	+ 8.25	- 54.4	- 6.86	+ 66.3	36.51	86.7
11	+ 11.43	- 26.9	- 10.78	+ 40.4	- 36.49	- 96.5
12	+ 12.94	+ 4.4	- 13.35	+ 9.5	36.24	105.7
13	+ 12.50	+ 34.9	- 14.29	- 22.5	- 35.75	- 114.1
14	+ 10.12	+ 59.8	- 13.58	- 51.8	35.02	121.7
15	+ 6.13	+ 75.0	- 11.46	- 75.6	- 34.07	- 128.5
16	+ 1.15	+ 77.9	- 8.27	- 92.3	32.90	134.4
17	- 4.00	+ 67.8	- 4.39	- 101.2	- 31.52	- 139.3
18	- 8.48	+ 46.6	- 0.19	- 102.4	29.94	143.4
19	- 11.56	+ 17.9	+ 4.01	- 96.3	- 28.18	- 146.5
20	- 12.82	- 13.6	+ 7.94	- 84.0	26.24	148.6
21	- 12.11	- 42.9	+ 11.35	- 66.4	- 24.14	- 149.8
22	- 9.62	- 65.7	+ 14.06	- 44.8	21.90	150.1
23	- 5.75	- 79.1	+ 15.90	- 20.6	- 19.53	- 149.4
24	- 1.08	- 81.2			17.04	147.7
25	+ 3.73	- 72.0			- 14.46	- 145.2
26	+ 7.99	- 52.8			11.80	141.8
27	+ 11.11	- 26.1			- 9.07	- 137.5
28	+ 12.60	+ 4.3			6.30	132.5
29	+ 12.19	+ 33.9			- 3.50	- 126.7
30	+ 9.89	+ 58.1			- 0.69	120.2
May 1	+ 6.02	+ 72.9			+ 2.12	- 112.9
2	+ 1.17	+ 75.5			4.91	105.0
3	- 3.85	+ 65.9			+ 7.66	- 96.7

Note on Stationary Radiant Points. By Richard A. Proctor.

It is hardly necessary for me to point out that the results indicated by Mr. Denning, in the June number of the *Notices*, with regard to meteoric velocities, and his supposed recognition of stationary radiants, are not congruous. A radiant really stationary for three or four months, or varying only by a degree or so in that time, implies *of necessity* a velocity of meteoric motion many times greater than the velocity of the earth in her orbit.

Unless Mr. Denning has been deceived by accidental coincidence of the radiants of really different streams (which is not unlikely in some of his instances), we must assume that either his observations do not determine radiants so closely as he has supposed, or else the velocities deduced from multiple observations for meteors of these streams cannot be trusted. More probably both sources of error exist.

If (1) we reject as mere chance coincidences all stationary radiants lasting more than two months or so; (2) assume that none of these radiants have been determined within less than three or four degrees; and (3) suppose that in the case of streams having radiants thus far stationary, there are velocities ranging up to about 150 miles per second, incongruity disappears, and Mr. Denning's observations are treated with the least possible violence.

My own theory antedates Mr. Denning's observations by ten or twelve years, and is in no sense affected by our way of viewing them.

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